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CONTENTS:

	PAGE
Important Turn in the Lamp Situation in America	577
Electrical Installations in Explosives Factories and Magazines	578
Consultants in the Electrical Profession	579
The Value of Combination Stations	581
A Contribution to the Study of Alternating Currents (*illus.*) ...	582
Central Electric Light Stations.—Yorkshire House-to-House Company's Supply at Leeds (*illustrated*)	583
The Wiring of Houses for the Electric Light	588
Nicety in Terms and Accuracy in Definition	589
The British Insulated Wire Company (*illustrated*)	590
Electric Lighting of Malta	591
Legal:—The Grosvenor Gallery Electrical Machinery	592
Birmingham Telegraph Factory	592
Electric Arms and Ammunition Syndicate *v.* Lucas ...	592
Woodhouse and Rawson United	592
Fowler, Lancaster & Company	592
Notes	593
Contracts Open and Closed	597
Business Notices, &c.	598
City Notes, &c.:—London Electric Supply Corporation ...	599
Yorkshire House-to-House Electricity Company	600
Elmore's Patent Copper Depositing Company	601
West India and Panama Telegraph Company	601
Traffic Receipts	601
Share List of Electrical Companies	602
The Columbia Lamp Company's Suit (*illustrated*)	603
The Royal Society Conversazione (*illustrated*)	605
New Patents	606
Abstracts of Published Specifications	606
Correspondence:—	
Relative Safety or Danger of Electric Light Currents ...	607
Parks Modification of a Wheatstone Bridge	608
The Comparative Costs of Heating by Electricity and Gas Coal	608

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IMPORTANT TURN IN THE LAMP SITUATION IN AMERICA.

THOSE of our readers who have followed the events recorded in our past issues on electrical affairs in America, will be aware that further lamp cases, instituted by the General Electric Company, were pending. The first of these since the one heard by Judge Colt at Boston, came on for hearing on April 11th, and it was against the Columbia Incandescent Lamp Company, a comparatively insignificant concern carrying on lamp manufacture at St. Louis. Public interest in the Goebel defence, which it was understood was again to be used, had begun to flag, and the case in question, after having been postponed more than once, attracted but little attention. The world is now startled by the news that the preliminary injunction demanded by the General Company has been refused. It must be borne in mind that the opinion just delivered is merely a preliminary one which is based on the evidence of a number of affidavits and exhibits, and it therefore forms no certain criterion of the ultimate decision that may be arrived at, or of the effect it may have on the electric lighting industry generally. The ultimate conclusion can only be settled by a regular trial, which, unfortunately, will take a long time to prepare, owing to the numerous witnesses who will have to appear, and it is a question whether the Edison patent will not have expired before the case is finally disposed of. The decision just delivered does not even temporarily throw the market open to any material extent, since only the Columbia Company and a few other undertakings, who have not yet been legally restrained, can continue to manufacture lamps. Those factories which have already been closed cannot, we understand, recommence work until the several injunctions laid on them have been removed, a proceeding which can only be effected by bringing the matter into Court again in the various circuits, on the ground of new evidence; and it is impossible to say whether Judge Colt and others would regard such evidence in the same manner that Judge Hallett has.

These circumstances, however, do not prevent the decision from being one of great moment, and the succeeding moves will be watched with intense interest all over the world.

We give a synopsis of the case elsewhere in this issue. It will be seen that the defence was argued in a most able manner by Mr. Kenyon, but, as a matter of fact, the case hung entirely on the Goebel story, the truth of which is, to our mind, still far from being conclusively proved. Several additional affidavits, 150, or more, in all, and some fresh exhibits, were put in, but none of them had the uncontrovertible evidence that would have been contained, for instance, by newspaper descriptions, illustrations or other documents. It is clear that there is falsehood on the one side or other, but without the assistance of searching cross-examination it is difficult to ascertain on which side it exists. The testimony supporting the Goebel story is, it is true, exceedingly voluminous

and consistent, while the attack on it by the plaintiffs we admit is very feeble. The story thus receives much indirect strength, but volumes of written evidence of this description is not necessarily actual proof in a case where perjury seems perfectly evident.

One weak point that strikes us in Mr. Kenyon's summing up is the explanation given for the Goebel matter not having been brought up in prior suits. The early knowledge of the matter is admitted by both defendants and plaintiffs. In the Boston trial, the reason given by Mr. Curtis for its non-use was, that he did not sufficiently understand the extent to which Goebel had carried his experiments, and that, had he known that evidence to the extent produced was forthcoming, it certainly would have been used; whilst, on the other side, the reason assigned was, that Goebel was unreliable, and had no old lamps to produce. The new explanation is that each side sought to hide the naked truth through self-interest. The Sawyer and Man Company hoped to have its patents sustained, and the Edison Company hoped to have its own triumphant, and thus it was to the interest of neither party to disclose the poor and unknown claimant to the incandescent lamp, and so let real equity reign. If *interested motives* are recognised as rational and sufficient reasons for hiding assured historical facts, what wonder that the affidavits presented on either side differ in their testimony in the manner they do; and on this ground, what is there to prevent the whole Goebel story from being a fabrication?

Assuming the story to be true, there is no question that the defendant company is entitled to its victory. Judge Colt shirked the question in regard to the lamp exhibits Nos. 1, 2 and 3, by expressing the opinion that the devices were not practicable incandescent lamps, and that there was, therefore, no need to decide on their genuineness. He accordingly decided the case almost solely on the lamp exhibit, No. 4, which he held was not a genuine production. The question of the filamentary character of the carbon, which is manifestly used in the exhibits Nos. 1, 2 and 3, was not clearly put before the judge as being the crucial point at issue. But in the present case, the principal argument was the one of the attenuated carbon of high resistance, being the only point of novelty in Edison's patent; and that if it could be shown that it had been used before as an illuminant, then the patent must necessarily be nul and void from want of novelty.

The decision is naturally viewed in various aspects by the several persons who are interested in the lamp industry. Whilst all of those who side against the policy of the General Company, are naturally more or less pleased at the result, they are by no means all convinced of the truth of the Goebel story—especially those who, like Mr. Ward Leonard, find it difficult to believe in modern miracles. On the other hand, one of the counsel representing the General Electric Company, is said to have expressed his views to the effect that while Judge Hallett's decision was unquestionably a reverse, it was regarded as only a temporary one. Similar injunctions had been refused to the Bell Telephone interests, but they had been without final effect; and steps to bring the Columbia case to a final hearing will be vigorously proceeded with.

The statement made at the conclusion of the defendant's summing up to the effect that the plaintiffs have now a case before the Supreme Court with the object of extending the life of Edison's patent until 1897, will come as a piece of interesting news to many persons in Europe.

ELECTRICAL INSTALLATIONS IN EXPLOSIVES FACTORIES AND MAGAZINES.

Her Majesty's Inspectors of Explosives have just issued their annual report for the year 1892. It will be remembered that at the end of 1891 some regulations affecting the electric lighting of explosives factories were drawn up by the Inspectors, and published in the last annual report. These regulations were based upon the Phœnix Fire Office rules for electric light installations.

The report states that the working of these regulations has been tested in several factories, and subjected to criticism by Major P. H. Cardew, R.E., the electrical adviser of the Board of Trade, who has accompanied the Inspectors to several of the more important factories in which the electric light is installed, and has examined the arrangements and discussed them with the manufacturers. The result of this observation, criticism, and enquiry, has been that in some particulars modifications have been made in the rules, and slight relaxations of the precautions which were laid down, have been allowed in factories where installations had been previously established. In consequence, it has been considered desirable to issue an amended memorandum, embodying these modifications and relaxations in substitution for the original memorandum of December 31st, 1891. This amended memorandum is given in a special appendix.

The appendix opens with some introductory observations respecting the experiments at the Royal Gunpowder Factory, Waltham Abbey, which showed that when a live incandescent lamp is broken, powder dust may be fired by contact with the filament. The insecurity of such lamps in the drying rooms, of explosives factories, unless special precautions are taken, is insisted upon. Attention is then called to the "probably more formidable risks connected with the wires, and the possibility of short-circuiting, heating of conductors, and sparking." Special stress is laid upon the importance of continuity of lighting, and it is suggested that in the case of certain buildings suitable provision should be made for ensuring this by the use of two or more independent supplies, or by the employment of auxiliary storage batteries and two or more independent circuits.

Then follows 17 special rules, the substance of which is as follows:—

Arc lamps may not be used. Incandescent lamps should be protected by at least one strong outer glass globe, so proportioned in size that the outer globe shall not exceed 140° F. in temperature. In specially dangerous (dusty) areas, the lamps should be immersed in globes containing distilled water, or placed in globes perfectly sealed by elastic washers, liquid joints, &c. If water be used in the outer globe, one side of the globe should be painted to prevent the concentration of the sun's rays.

It is considered desirable in the case of very dangerous areas that the means of lighting (wires and lamps) be *external* to the building, and should be accessible only from the outside. In such areas, the conductors should be completely enclosed up to the outer globe of the lamp itself in metal or other non-flexible incombustible casing, so sealed as to be dust-proof, and this casing, if metallic, should be efficiently connected to earth in several places. The lamp

wires must be soldered to their leads, and not fixed in the ordinary holders provided with contacts, or if holders be used, they must be of such a pattern that an imperfect contact cannot be produced by oxidation or mechanical failure; and no screw clamps or terminals for connecting the leads, except at the distributing centre, are allowed; nor must there be any joints in the leads in the vicinity of a danger area.

Each separate wire, whether branch or main, must be efficiently protected by a fuse or cut-out not less than 1 inch in length, placed outside the danger area, and arranged so as to be readily inspected; the fuses must consist of tin wire, and no single wire must be thicker than No. 20 S.W.G., additional wires being added in parallel if required.

Double-pole switches are recommended, by means of which the conductors to a lamp can be completely disconnected from the source of supply; these are to be placed without the danger area.

A safe and efficient leakage detector is to be permanently connected with the system of lighting and placed in a conspicuous position in the dynamo room.

Underground conductors are recommended wherever practicable. No wires are to be subjected to mechanical stress, vibration, &c.

The arrangements adopted to protect the mains and wires generally from the effects of lightning, where such mains and wires are unavoidably exposed, have to be such that in no case would it be possible for the supply current to follow the lightning discharge; in other words, that it would not be possible for the discharge to establish an arc fed by the supply current. (It is suggested that in the case of overhead wires a piece of barbed fencing wire run above the electric lighting wires, and connected to earth at each pole, would form a desirable protection from lightning.)

It is laid down that the electrical pressure between any two conductors, or between any conductor and the earth, should in no case exceed 110 volts in the immediate vicinity of any danger area elsewhere; within the licensed area of a factory or magazine, 300 volts if continuous, or 150 volts if alternating, are allowed. Finally, stress is laid on the importance of inspection and proper maintenance of all the electrical installations, and it is pointed out that it is essential that a thorough system of inspection and testing should be provided, and that the whole installation should be maintained up to the original standard as regards insulation and mechanical strength.

CONSULTANTS IN THE ELECTRICAL PROFESSION.

OUR lively little contemporary, *Lightning*, has shown cause for its existence lately by many departures from the beaten track of technical journalism.

Mr. Andrew Reade, a well-known writer on commercial topics, has recently said, when writing on the modern principles of successful advertising: "Never mention your competitor; don't let the public know you have a rival. Should you refer to him, do so in the shortest of terms, and dismiss him and his affairs as briefly as possible. If you do not you are giving him a gratuitous advertisement—one which is all the more advantageous by the probability of its appearing to savour either of malice or fear." We are inclined to agree with Mr. Reade in his ideas, but our contemporary, at its inception, took the novel course of giving not only a reference to, but also a fairly full review of ourselves and neighbours weekly, so that it is but a *quid pro quo* to do likewise with our somewhat meteoric, but brilliant critic.

There are matters in the more commercial walks of electrical work which have by common consent been debarred from discussion or publicity, and although they have formed topics of conversation vieing with the state of trade and the weather in chance conversations, they have been hid from public gaze as something which only those within the pale should be permitted to know.

The mystery as to prices, fees, discounts, commissions, rebates, and terms of payment has had more or less light thrown upon it by recent disclosures, some of which have been voluntary and others forced. In invading the sacred precincts of the consulting engineer's sanctum, *Lightning* has succeeded in placing on record the terms upon which six well-known firms and individuals are prepared to advise bodies of the *status* of local authorities.

An attempt to cover the personality of each reply with anonymity is hardly likely to be met by more than a gentle smile on the part of the knowing reader. Although no one has had the boldness to place on paper the information, the items with which it deals have in a floating way been common property of the profession. It is a question how far it is either safe or expedient to print *in extenso* such matter as this. We well remember the hubbub occasioned by like action on the part of a trade journal some time ago, when speaking of discounts.

As individuals go into trade or professional work for the sake of the income accruing therefrom, the province of journalism should be to respect the privacy without which no transactions are possible, and to deal very superficially and lightly indeed with such features as are usually accorded secrecy by unanimity of professional etiquette. The information is, no doubt, of great interest to beginners in the *rôle* of consultant, but the actual value can only be in enabling them to under-cut what they know to be the price set upon their services by men of established position.

In such times as the present, private individuals and firms make it a general rule to buy in the cheapest market, and public bodies are not slow to follow the same course. The rage for economy has in a few instances tended to the "cheap and nasty," but it cannot fairly be said in the general aspect to have done more than to have embittered competition, and reduced the margin of profit to producers of manufactured articles; and in the case of brain work to have lessened the incomes of professional men, and given a chance to able but comparatively unknown advisers. This gives an impetus to a general dead-levelling up of talent. The result is not wholly to be regretted in itself, though no one more than ourselves have been down on the illegitimate and almost insane cutting of prices to which we had occasion to recently refer.

Nowadays the spread of education and the general increase of opportunities offered to the middle classes have caused

a very great change from the old days when engineers were born, and not made. Men like Stephenson and Brunel, and others of the old pioneers were prominent in spite of circumstances, and the competent few could be numbered on the fingers, whereas we are convinced that the vast majority of men engaged in practice to-day are to a great extent of equal ability, the circumstances and influence in each case doing far more to determine their success or mediocrity than mere capability or personal attributes.

To the last paragraph, therefore, of our contemporary's article, we would give an unqualified denial. Men with excellent qualifications and thorough grasp of their professional duties are so numerous, that a Corporation should be able to find an unlimited number, of whom any one would prove a satisfactory official, when the salary offered for a resident or managing engineer is about £200 per annum to commence with. Consulting engineers should be chosen from the highest ranks of those engaged in this branch of the profession, and there is little to find fault with in this respect in recent municipal selections.

If commercial undertakings can find men to do their work at salaries of £150 to £250, and do it well, too, it would be mere extravagance for corporate bodies to offer much higher sums.

It is a matter of common knowledge that some of our most successful undertakings are in the hands of such men. To wit, a town on the South Coast, which was one of the first to adopt electric lighting, was supplied by a company of whom the late and much respected manager was a man of no brilliant parts, but a most efficient engineer, although his remuneration was known to be such as falls within the scope of our remarks.

A man has to be somewhat of an expert in some special branch to command salaries of the amount stated. The exceptions with which everyone must have had some experience only go to prove the rule. We also know the class of men whom *the* premier firm of this country pay at such a rate, and it is not too much to say that any one of them would be—in actual instances have proved themselves to be—quite capable of fulfilling to the utmost the requirements of a municipal appointment. At the same time they do not, and cannot take the place of the consulting engineer; nor would it be desirable that this should be attempted.

Experience has proved, in the majority of cases, that the selection of officials by Town Councils and like bodies, has been attended by happy results, and that the present system in this respect is not so far from what it ought to be as some people would have us believe.

Photometry.

That photometric data are often of an exceedingly unreliable character goes without saying: moreover, the fact that so many different "standards" and methods exist in different countries, is, of itself, evidence of the insufficiency of modern photometry. In Germany, the standard is a paraffin candle of given dimensions; in France, the official standard is the Carcel lamp, but the stearine candle is very frequently resorted to; in this country and in America, the spermaceti "six" has not yet been completely supplanted by such devices as the "Harcourt" air-gas or pentane flame, the "Methven screen," &c. The Paris Academy of Science has recently had under consideration a new photometric standard, namely, phosphorescent zinc sulphide. Mons. C. Henry, who brought it forward, states that the quantity of light emitted by a surface of phosphorescent zinc sulphide at a given moment, is within wide limits, which correspond with luminous saturation, independent of the distance of the exciting agent (burning magnesium), of the time of illumination, and of the thickness of the layer of zinc sulphide. The law of the loss of luminosity of phosphorescent zinc sulphide is invariable, even though specimens be tested which may have been prepared by different chemists; the initial intensity of the luminosity may vary however. Mons. Henry finds that this law may be expressed by the equation

$$i^m (t + c) = \text{K},$$

where the value of $m = 0{\cdot}598$ and $c = 28{\cdot}35$. Further details of the standard, which may prove a serious rival to other standards, will be found by consulting the *Comptes Rendus*, cxvi., p. 98.

Electrical Transmission and Indicators for the Movements of the Tiller.

A paper with this title has recently appeared in the *Rivista Marittima*, by Vittorio Moreno, and a translation is given of it in the *Journal* of the Royal United Service Institution for March. It occupies three pages, and there are several illustrations. The large amount of gearing on board ships for the transmission of movement to the various steam or hydraulic engines for steering purposes, is sometimes, under ordinary circumstances, the cause of so much inconvenience, that it is necessary to have recourse to steering by hand. In action, the effect of projectiles might easily interrupt the transmission to the engines of the steering gear, and with a large ship which could not be steered by hand, in such conditions her safety would be compromised. Moreno's paper describes an auxiliary system which can be installed at small cost, and which assures the good action of the tiller. The first study of this question was made in 1887 on the *Italia*; the second trial was carried out on the *Lepanto*, and now the system has been perfected. The following account will convey some idea of the leading features of the system, but for details the diagrams accompanying Moreno's paper must be consulted. A small electric motor (Siemens & Halske) transmits movement to an endless screw, which gears into a toothed wheel fixed on a spindle, which, by means of two bevel wheels, gives the same movement to a "Forester's" differential valve. The upper part of the spindle is connected to the steering wheel on deck, and is geared automatically. When the current passes in the coils, a magnet attracts a lever and disconnects the upper spindle, which returns again in gear when the current ceases. According as the motor revolves in one direction or the other the movement of the rudder is to right or left, and nothing is changed in the ordinary fittings for transmission. The motor takes a current of 8 ampères with 60 volts at the machine terminals, and is furnished with carbon brushes. In order to regulate the velocity of the motor, an automatic regulator is used. An "inverter" provides communication with the generating dynamo and the motor. There is also an ingenious arrangement for breaking contact and stopping the motor by means of a counter current, which acts on the magnets of the motor itself. When the tiller arrives at the end of its course, or, better, some instants earlier, corresponding to an interval of 2°, an electric bell is set in action, which warns the helmsman that the tiller is "hard over." A great feature of this installation is an electric indicator, which faithfully reproduces the movements of the tiller. For a description of this the original paper and diagrams must be consulted. Moreno states that with this system the "Forester" valve has an easy and uniform motion, and is not subjected to heavy shocks, as is the case with mechanical transmission, and the helmsman, by means of the indicator, which reproduces the movements of the tiller with the most desirable accuracy, is enabled to carry out the orders of his commanding officer with corresponding precision.

THE VALUE OF COMBINATION STATIONS.

THE term, combination station, is a short way of expressing the idea of a central station whose load is made up of diverse classes of supply. To some extent a station operating plants of different types, such as incandescent machines and arc lighters, is a combination station, but practice has caused to be associated with the term the conception of dissimilarity in the utilisation of the electricity. There is no factor of more importance in our modern industrial life than the tendency to specialisation in each and every department of labour, be it of brain or muscle, and in electrotechnology, owing to its recent growth principally, this is more apparent than in other cases of older standing. In the States and on the Continent the results are even more evident than they are at home, and herein lies one of the great differences which cause arguments applicable enough to one set of conditions, to be valueless when applied to those of others whose surroundings are materially different. The appliances used in various callings are being specially treated with a view to increased effectiveness, the object of modification being often attained at the cost of general utility. It may happen that a tool is altered and rendered more efficient for a particular class of work, while its cosmopolitan character is sacrificed. If this be carried out ruthlessly and commercial considerations be ignored, while from a restricted view the change is desirable in itself yet it may be that it is only obtained at too great a final cost.

In discussing the advisability or otherwise of accepting the principle of combination as applied to central stations, it will be necessary to have this in our minds. We have seen in the last few years how the demand for prime movers in connection with generating plant has called into being a novel and special class of engines, and as the applications of electricity become more common, the dynamo is modified so as to meet its work in the best possible way in each individual case. As has been pointed out, handling one class of central station business is to a considerable extent different from that of another, and the responsible manager must therefore either have had experience in both lines, or be willing to take the advice of men who have had.

The suggestion of combination usually arises in the cases of towns adopting electric lighting as a municipality, and either possessing the tramways or having in view the taking of them into their own hands. As franchises and leases run out there is a likelihood of this question forming a topic of discussion throughout the country, as it has already done at places like Bolton and Blackpool. Unfortunately, as we have had prominent examples, those into whose hands the subject falls for settlement are not always the most competent to judge between conflicting opinions, or to impartially weigh the pros and cons of a somewhat involved and complex matter. It may, however, be generally said that the best site, *cæteris paribus*, for a power station for tramway purposes is that most suited to the electric lighting station. In a few years this will be even more correct than it is to-day. The rich and remunerative districts, from a lighting point of view, will not alone possess the boon of a general supply of electricity, but the whole area of our larger towns will be afforded the opportunity of utilising electric energy for any or all of the functions it so well performs. An electric power station does not differ from an electric lighting station in principle, nor would practice and experience advise any divergence between the boiler house arrangements in either case. In the matter of prime movers, the engine power might well be a repetition of that found in some of our most successful lighting stations. So far, the mechanical arrangements involving the production of power from coal have to be treated in the same way as the driving plant for a mill, or any other instance of aggregated plant of a considerable horse-power, and the requirements for central station work must be fulfilled so far as this is concerned, whatever may be the ultimate aim in the generating process. As the areas covered by our towns become included in supply areas, so will either the number of stations increase, or sub-stations on a converter system of some kind be brought into use. In this way, it seems very probable that electric power, suited in its pressure, volume, and capability for withstanding sudden changes of load, might with an encourging amount of commercial success be given from a plant located under the same roof as that for general supply, perhaps even having common boiler power with it, and under the same management. As was pointed out above, the present position of electric lighting is not one which has permitted in many cases of large towns being fully supplied, and the result followed that the stations in existence are in many instances so situated as to be badly off were they to have the plant for tramway work laid down conjointly with that for lighting.

This question of uniting several sources of revenue in one station, so that each would help the other to a position of profit-making, is like many others which have been seized upon by town councillors, and treated to a notoriety which reminds us of the blessed word Mesopotamia in the creed of the old lady whose heart did her more credit than her head. So with this, under certain circumstances the results might be so beneficial as to render the neglecting of such a joint arrangement the grossest imprudence and negligence; but, on the other hand, to imagine that in all cases this union of different branches of supply would tend towards success, is to own to an appalling want of knowledge of the highly specialised condition into which both of the branches of electrical engineering to which we have referred have developed. It must be remembered that the dynamos, regulation, mains, and even the character of the load on a tramway or railway power system, is of quite a different nature to what is encountered in connection with supply for lighting purposes, and separate attendance would be a *sine quâ non* on a station of any importance. We shall have a good opportunity of judging how far theoretical reasoning, guided by the practical experience gained in this country, can be relied upon as being correct when results are forthcoming from Blackpool, although what has been arranged to be carried out there is not sufficiently general in its character to permit of either sweeping denunciation or complete acceptance of the principle. So much for what has been done in this way in our own country. We must look to the States for further information, for there it is that this subject has received most attention. Owing to American methods and necessities, it is as old as the commercial electric railway itself. A symposium of views discussing the question of combination stations has been published in the *Street Railway Gazette* of Chicago, and the contributions are from the pens of several well known and influential men in the tramway and railway world in the States. Probably Dr. Louis Bell and Mr. S. H. Vail are those best known in this country, and they are both on the staff of the General Electric Company; but it is instructive to note that they take diametrically opposed views on the question at issue. Unfortunately no prominent name associated with the subject of electric traction appears at the head of an article, although the professorial element, as usual, appears in its strength. There should be greater capabilities of judging as to the actual benefit to be derived, as examples of combination stations at work are not so rare; indeed, it is said that almost scores of stations could be enumerated which are now operating both railway or tramway and lighting systems. It is difficult to recall one example in England, however, so that we can afford to look at the results and opinions prevalent where such experience has been gained. The Sprague Company, on the extensive system at Richmond, Va., obtained current from generators placed in the already established electric light station. This was also the case with the first lines operated by electricity on the West End system in Boston. The Thomson-Houston Company availed themselves of the Cambridge lighting station for the location of their plant, and also installed railway generators in the Edison station in the centre of the city. As would be expected, the conditions of life in the States, and the methods pursued in affairs commercial and technical, differ vastly from what we are in touch with in this country. The expression of opinion, therefore, as to technical points with reference to work on the other side of the Atlantic, will not bear with any degree of force to similar cases in this country. Of the writers who deal with the subject of combination with reference to American practice, there are eight in number, seven of these dealing with controversial views of the question, and one with the laying out of such a station, assuming the preamble held proven. Various grades of combination between two interests are referred to by different writers. Some assume that the machinery for one class of demand is kept separate from that for the other, while the

prevailing idea, especially amongst the professorial element represented, is that the additional demand is of a nature and amount to be dealt with by the existing machinery, and tending to fill up the valley of the load diagram rather than increase the height of the peak, while, at the most, the only capital expenditure involved would be a small extra reserve of plant capable of dealing with either class of supply. It is well to remember that the union between what we have been considering as two classes of consumers is, with relation to their supply, capable of mixed treatment, and it is not altogether profitless to sift the views advanced by the American writers, when they have been, as far as possible, brought to a common foundation. As Prof. Roberts points out, it is not generally advisable to operate lighting circuit and street railway circuit from the same engine. That is to say, consolidation or centralisation can be carried too far. If, as one would hardly expect to be the case, the railway or tramway load was small compared with that for lighting, then such an arrangement might be beneficial, but it is a possibility which could only be discounted at ruinous rates. The consensus of opinion seems to very fairly take into account the advantages to be derived in the case of a small town, say, of not more than 25,000 inhabitants, and the disadvantages which militate against any such proposal, for where "there is a decent business for the lighting and the railway company, separate stations would usually be better, financially, for both." Were the interest in the subject in this country as strong as in the States, or its importance of moment, much might be said upon its bearing on existing and projected schemes in our provincial towns.

In the Metropolis it is unlikely that any such putting of eggs in one basket would either be sanctioned or seriously considered, and the magnitude of the work with which we are concerned in London is vastly in excess of such interests as those dealt with by our contemporary. No doubt steam production on a large scale is beneficial, the economy being enhanced as the output and constancy of demand is increased. Boilers might therefore be reasonably conceded to be common. In small towns one plant might serve for general supply and for tramway service. On larger schemes two sets of plant might be run in one station, and where this was not desired one staff might still be arranged to attend to two stations side by side. So far the engineering view has been set forth, the advisability of consolidating financial and business interests has not concerned us; certainly, American views on this point are little *apropos* on this side of the ferry. A case not unlike what would be found to exist in an instance of power rented by a lighting company to another for traction purposes is that at Southampton, where the lighting company are contractors for electric power supply to electric cranes on the Dock estate. The maximum demanded supply representing the energy absorbed when the cranes are hoisting and slewing, is more than equal to the total lighting demand. We are not at liberty to give figures, nor would they, if published, be germane to our subject, but we shall watch the results with lively anticipation. It is no light thing for a station to have thrown upon it, or suddenly removed, even 10 per cent. of its load, and on some of our best known supply systems the greatest trouble has been experienced from the variation due to meter testing, loads of 80 to 100 ampères being quite sufficient to cause "blinking" of the lights, whether on a low direct or high tension converted supply. We should, therefore, hesitate before flying from the evils we know to those we wot not of.

The ideal arrangement of plants having units of diverse construction, each applicable to one class of business, and in accordance with the latest American views, bears a marked resemblance to the standard design of the Westinghouse Electric Company, which is well known in this country. One feels quite thankful when a design appears in which the engines and dynamos are on one floor. Vertical or diagonal drives with heavy belts are eyesores to those who are in touch with the cream of European works of a similar nature. The demand which might be expected in a town of 20,000 to 25,000 souls is taken very reasonably at 100 arcs, 3,000 incandescents, and 10 16-foot tramcars. The plant to supply these would be accommodated in a building 150 feet by 50 feet. The need for such a station would arise upon the creation of a company having a well defined object in view from the first, and preparing their plans so as to render the chance of future completion in either field, if not impossible, at least improbable. At the same time it could compete with a gas plant, and yet show a handsome return. With respect to location we are told that a site should be chosen convenient to railway tracks, and as near the centre of the town as the relation between cost of real estate and value of mains and feeders will allow. Of course, this is a loose way of stating the Ayrton-Thomson law slightly modified, and it is easily understood in its bearing, although perhaps no professorial dogma has been so misunderstood or misused and misstated, as this unfortunate attempt to carry purely mathematical fiction into the sphere of engineering. At the back of the building the boiler room would be located, with three 150 H.P. boilers set in brickwork, with novel furnace door arching of firebrick. Two pumps, each of ample capacity to feed the whole of the boilers, and a heater face the boilers, while storage for 100 tons of coal is provided. An arrangement of steam piping is suggested, which is open to comment. Shortly, the idea seems to be to duplicate the steam supply, from boiler No. 1 to engines Nos. 1 and 2, the former doing tramway driving, and the latter being belted to incandescent machines. To be of any service, duplication of steam engines must include the boilers as well as engines, and if worth attempting at all, a ring main forms the simplest and most rational precaution which can be adopted. Four engines, horizontal double-flywheeled, and apparently of the Armington-Sims, or allied types, of 150 H.P. each, drive the generators as follows: — No. 1, two tramway machines; No. 2 and No. 3, each two incandescent machines; while No. 4 takes the arc lighters, of which there are two, dividing the 100 arcs between them. At the front of the building and looking on to the street are, left and right of the entrance, the store room and office; the latter having window in partition wall enabling the chief to be constantly cognisant of the operations in the engine room. Simplicity approaching bareness in the station building is advocated; solid brick walls and metal roof. The floor of the engine room is recommended to be of maple, and stress is laid upon the desirability of cleanliness being carried almost to a fault. The mention of concrete floors and their action as a *bête noire* to all bearings unlucky enough to be near them, shows that experience soon levels up opinions, despite that "a great many engineers favour" such flooring.

York flags have in this country been found unobjectionable, and possess features of convenience, while being eminently suitable where traffic is heavy. Blue Staffordshire bricks or tiles have been used with benefit and pleasing results, and in the case of a completed station go well with the machinery, making a pleasing whole. The remark that wires should not be brought in at the cupola is foreign to English work, and the risks referred to as being due to this are luckily unknown in this country. While upon the subject, it might be remarked that, although the prevailing tendency to utilise closed in high speed single action engines for lighting machines has much to recommend it where power is more particularly the source of revenue, the inertia of the moving parts of engine and generating dynamo is of vastly greater importance than in the other case, and should we find that a consolidation of interests would in any instance be desirable, the most satisfactory combination station would be one with entirely separate power plants, taking steam from common battery of boilers whose water capacity was not stinted. The study of the economics of combination is commended to those local authorities who still come under the head of "doubtful" as to the advantages of taking up electricity supply, for with two strings to their bow they might discover a marked improvement in the prospects of their venture.

A CONTRIBUTION TO THE STUDY OF ALTERNATING CURRENTS.

The current volume of the *Journal Universel d'Electricité* contains an interesting article, signed by P. Marcillac, upon a new development of the "Tesla" researches. He refers to the well known phenomena which are manifested when Giessler tubes charged with various gases are associated with the current from an induction coil. These phenomena may almost be termed classic, but Mons. Marcillac has suggested

an arrangement of the apparatus with which they are commonly produced which gives results which appear to confirm, within modest limits, certain of Tesla's suggestions on the subject of the influence of conducting surfaces on the rarefied gases within the Giessler tubes.

Let an ordinary Giessler tube be placed in relation to a Rhumkorff coil and a dish of water, as shown in fig. 1,

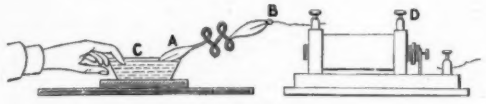


FIG. 1.

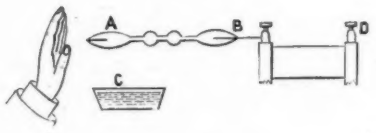


FIG. 2.

where A and B are the platinum electrodes of the tube, C a porcelain dish supported on an ebonite disc and containing the water. The disc itself rests upon a plate of glass; D is the second and free terminal of the induction coil. A current is sent through the primary coil, the vibrations of the spring being so regulated as to produce a strident sound. The Giessler tube itself is now depressed so that its free extremity, A, slowly approaches the surface of the water, whilst this surface is touched with one finger. In spite of the resistance of the rarefied gas within the tube, plus that of the liquid, the glow is sharply defined; although the terminal, D, is free, and the circuit thus not complete.

As the finger is made to recede from the surface of the water, the glow within the tube slowly wanes, but remains for some little time. If the tube be now raised from the liquid, and the hand approached towards it in the damp or dry condition, the glow is maintained almost with its original intensity.

These phenomena appear not only when water is used in the porcelain dish, but when such liquids as salt and water, copper sulphate solution, &c., are employed.

In these experiments Mons. Marcillac used three Lalande and Chaperon elements, such as are employed in microphone work. The coil was of the ordinary Rhumkorff type, the vibration being 0·10 m. in length, and 0·03 m. in diameter, and of particularly sensitive balance. The Giessler tubes were of the kind usually employed to show the glow discharge.

The return circuit is sufficiently completed by the air, as Tesla showed last year; but this is facilitated by fixing upon the free terminal of the coil a conducting plate. By augmenting the capacity of the system, the discharge current is increased, and the glow is consequently intensified. In the above experiments the hand and the dish containing the liquid play the same part as the special device employed by Tesla.

CENTRAL ELECTRIC LIGHT STATIONS.

No. 10.—Yorkshire House-to-House Company's Supply at Leeds.

It must be with a troubled mind that one approaches the history of electric lighting in Leeds. It is a record which, for vacillation and sheer incompetency, is the worst in the whole of the written pages of electrical history. It would be idle to attempt to defend the attitude of the Town Council, no excuse can palliate their feebleness of action. They decided upon a definite policy, the first breath of opposition drove them from their position, and finally they were constrained to burn what they had adored and to adore what they had burned. Yet, there was a time when the Town Council of Leeds bade fair to rank as the most progressive of municipal authorities in the matter of electric lighting. As far back as 1883 the Council of the Leeds Corporation voted to the Electric Light Company the sum of £10,000 to carry out an experimental system of electric lighting and to visit the principal electric lighting works. Six years later a report was submitted by the Electric Lighting Committee, showing that £10,233 had been spent. For this sum the Committee had been able to light the Free Library with incandescent lamps, and the Victoria Hall with arc lamps; the remainder of the money had been spent by the committee in visiting various parts of the Kingdom to investigate the systems of electric lighting. Yet this report was so little cognisant of its shortcoming, that it adumbrated a scheme for lighting which comprised some 37,000 lamps, and finally recommended the Town Council to apply for a provisional order to supply the inhabitants with the electric light. So little was thought of this scheme that in the following year another deputation was sent round to the electric light stations. What the views of this deputation were after touring the country we do not profess to know, but, at any rate, the Yorkshire House-to-House Company, who for years had vainly asked for permission, were in 1891 informed that no opposition would be offered to their application to the Board of Trade for a provisional order.

The Yorkshire House-to-House Company was not the only company which sought to obtain powers to supply light to the Leeds public. For some time there was a more or less keen competition with two other companies, the National Electric Light Company and another. What became of these two other concerns in the struggle we do not quite recollect. Whether from financial reasons, or other considerations, they became convinced of the hopelessness of the struggle, we cannot say, but certain it is that they dropped quietly out of the competition, and left the House-to-House a comparatively easy task. The lamentable dissensions of the Town Councillors further aided the company in its efforts to obtain lighting powers, and after being repulsed more than once, its persistency was rewarded by a valuable provisional order. We think that much credit is due to the House-to-House organisation for the manner in which they have persevered with their claim, and they certainly deserve all they will obtain. It is a remarkable instance of what may be done by perseverance when opposed to municipal vacillation.

The company is one of the numerous House-to-House companies which were projected on the lines of the London Company. At the present moment few of these have been called into existence, but the particular system of supply with which these companies are associated has not failed to find many advocates.

The capital of the Yorkshire Company, about £100,000, was subscribed last year for the purpose of carrying out the supply of electricity in the area defined by the provisional order.

The system used is that of the Lowrie-Hall high-pressure alternating current, with house transformers, and differs very little in principle from that of the London House-to-House Company.

The Station.

The site on which the generating station has been erected is wonderfully well adapted to the special needs of an electric light station. It was the aim of the engineers to acquire, if possible, a position which would secure the advantage of a good supply of water, so that the company would benefit by the use of condensing engines, at the same time the easy delivery of coal was a valuable desideratum. In all respects the site, situate in Whitehall Road is advantageous. It has a frontage to the River Aire of nearly 100 feet, and it is sufficiently near the area of supply to keep the cost of the cables within reasonable limits.

The company advertised last May for tenders for supplying and erecting generating plant, but on the advice of the consulting engineers (Messrs. Hammond and Co.), that of Messrs. John Fowler & Co., of Leeds, for the supply of Fowler engines and boilers, Lowrie-Hall dynamos, and sundry other apparatus was accepted.

The buildings have the appearance of being well designed and there is abundance of room for extensions, one of the end walls being of a temporary character. The buildings are divided into engine-house, boiler-house, switch-room, test-room, workshop and offices. The engine-room is large and lofty, and 68 feet long by 63 feet wide. Ample space is allowed between the sections of machinery; a very

desirable arrangement where land is not phenomenally dear. A travelling crane, to lift 10 tons, spans the engine-house. Directly behind the south wall of the engine-house are placed the boilers, which are three in number, of the Lancashire type; they are nearly as possible in line with the engines, this arrangement reducing the length of the steam piping to a minimum. Opposite the front ends of the boilers are the coal bunkers; they are so near that stoking is rendered comparatively easy. Between the coal stores and the river is an ample wharf, on one side of which are placed the outhouses, water tanks, filters, &c. It is likely that the company will lay down a tramway in the yard space at disposal for the easy conveyance of goods to the different parts of the works.

The plant installed in the engine room consists of two 200 I.H.P. engines driving two 100-kilowatt alternators. and one 100 I.H.P. engine driving a 50 kilowatt alternator. The plant is capable of supplying 7,500 35-watt lamps. The engines are of the horizontal coupled compound condensing type, the size of the larger ones being considered by the engineers to be the most suitable unit to work in sections, having regard to the requirements of the business. The speed of the larger engines is 90 revolutions, the ordinary working pressure is 125 lbs. per square inch, but they will work without difficulty up to 140 lbs., and give each 250 I.H.P. as a maximum load. This provides for a good margin sufficient to meet all possible contingencies. The dimensions of the parts are: high pressure cylinder 14 inches diameter, low pressure 25 inches diameter, and stroke 30 inches. The slide bars do not consist of a cylindrical casting, but are made separate in two pairs to each cylinder in such a way that easy adjustment is possible. The bed plate of the engine is of the most massive construction. A noticeable feature is the strength of the crankshaft, and the length and surface of the bearings.

Injection condensers are employed in conjunction with these engines, the air pumps, condenser, and hot well being formed in one casting, and fixed to the bed plate at the back of the low pressure cylinder, the air pump being coupled direct to the low pressure piston rod working through the back of the cylinder cover. The engines are so arranged that they can be worked non-condensing in case of any failure of condensing water. They are also fitted with automatic expansion gear, controlled by powerful governors acting on the cut-off valves of both cylinders. The fly-wheels of the large engines are 14 feet in diameter. Special care has been bestowed on the lubricating arrangements. The oil in the bearings and working parts of the three engines is collected and carried by means of pipes to a cistern placed in the engine house floor, from which it is pumped into an oil filter, and, after filtering, used over again.

The engines are securely railed in, and between the foundation pillars and over the pipe trenches chequered iron foot plates are placed, making a very neat appearance.

The details of the smaller engine are as follows:—It has a speed of 120 revs., maximum at 140 lbs. steam pressure is 125 I.H.P.; the high pressure cylinder has a diameter of 10 inches, and the low pressure 18 inches in diameter, with a 20-inch stroke, the fly-wheel is 10 feet in diameter, and the fly-wheels are each grooved for rope driving, ten ropes of 1¼ inches diameter being employed.

The alternators are Lowrie-Parker multipolar type, similar to those in use at West Brompton, Madrid, Dublin, Eastbourne, and Brighton. It is claimed that in the dynamos at Leeds there are many points of improvement over earlier machines. They are self-regulating to about 16 per cent., this advantage being secured by a simple alteration in the design of the magnetic field. The working pressure is 2,000 volts, and, as in the case of the engines, allows a good working margin. The insulation resistance between the coils and the frame is about 15 megohms. The armatures and field magnet conductors do not carry more than 2,000 ampères per square inch of section. In order to provide for the perfectly safe working of the plant at every point, the terminals to which the high tension mains are connected, are securely boxed in by polished wood lagging, so that they cannot be touched except by the proper official. The cables are led away from these terminals in suitable trenches, which are rendered accessible by wooden traps let in the floor.

The exciters for the alternators are driven by ropes from a grooved pulley on the alternator shaft, and are each of ample size to generate a current sufficient for exciting the fields of the corresponding alternator without overheating. The exciting current is about 30 ampères, at a pressure of 120 volts for the 100-kilowatt machines, and 30 ampères at 60 volts for the 50-kilowatt machines. A special feature with all these alternators is that the grooved pulleys are not allowed, as in the earlier machines, to overhang, but are supported by outside bearings, which give a solidity and ease in working, which amply repays the slight extra cost on the first outlay, and the after cost of lubrication. The bearings are all long, and have large surfaces, being provided, moreover, with a water jacket and water fittings for use on emergencies. The machines are all provided with slide rails, by which they can be shifted without being taken off their foundations.

The Boiler House.

This has had special attention bestowed upon it, and is well designed and extremely convenient. As we have already mentioned, the boilers are of the Lancashire type, and are three in number. They are 30 feet long by 8 feet in diameter; they are specially designed to work at a pressure of 140 lbs. per square inch. Bennis's mechanical stokers are fitted to the boilers; these stokers are worked by means of a small engine driving by a belt on to a shafting, and then on to the shafting of the stokers in the usual way. A Green's economiser is used, consisting of 192 tubes, complete, with self-acting triple scrapers, lifting bars, guards, rod and chain, and improved gearing, with positive reversing lever, the scrapers being driven by another small donkey engine. The heated gases from the furnaces, before passing up the chimney, go through the economiser. This economiser was tested to 350 lbs. pressure before leaving the maker's works.

In case the engines are worked non-condensing, a feed-water heater is provided, by means of which the exhaust steam is used to heat the feed water.

After leaving the heater, the exhaust steam passes up to the atmosphere through a special pipe, instead of into the chimney shaft.

A very careful arrangement of steam pipes has been made. This was in fact rendered necessary by the number of auxiliary parts of the plant. Although a good supply of water was obtained by a river site, the character of the water is found to be very bad, there being a great deal of suspended matter in it. In order to meet this difficulty two water filters have been supplied, each capable of filtering not less than 2,000 gallons per hour. The pumps in conjunction with these filters are of the horizontal type, each capable of pumping not less than 2,000 gallons per hour.

The donkey pumps for feeding the boilers are of the duplex ram type, each of sufficient capacity to feed two boilers when working at their full power.

The pumps draw their water from the filters, and the feed pipes are arranged for delivering the water either direct into the boilers or to the water heater, and through the economiser to the boilers or through the economiser only into the boilers.

Fig. 1.—Vertical Section of Junction Box.

The main steam pipes are connected up in the form of a ring, thus providing two ways by which the engines can be supplied with steam, viz., from either end.

These pipes are provided with a suitable number of stop valves placed between each engine and boiler. The diameter of the steam pipe is 10 inches, and the whole ring is carried on brackets fixed to the wall of the engine-house.

The branch pipes from the main to the engines are of wrought-iron with wrought-iron flanges.

The exhaust pipes (to be used when the engines are worked non-condensing) lead off from under the low pressure

cylinders, and a stop valve is provided to each engine to shut off the exhaust steam.

Valves are arranged so that the whole or part of the exhaust steam can be turned through the heater or direct into the atmosphere through the roof of the boiler-house.

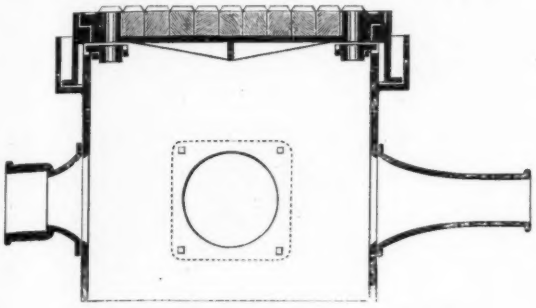


FIG. 2.—VERTICAL SECTION OF STREET BOX.

In connection with the condensers a main overflow pipe is placed to carry the injection water from the condensers and having a branch from each condenser. The whole of the steam pipes were duly tested by hydraulic pressure to 300 lbs. per square inch in the station.

THE SWITCHING APPARATUS.

The switching apparatus is placed in a special switch-room, and certainly makes a most impressive show. The apparatus is constructed under the Lowrie-Hall patents, and is very much on the lines of those in use at West Brompton. The apparatus provides for the simple working of each dynamo on to any circuit.

A synchronising board is provided, which is necessary when the alternators are run in parallel or when the load is changed over from one alternator to the other. The plant, however, is designed so that it can be run continuously in parallel. The synchronising is effected through the one-coil circuit; for instance, if one machine shows by the indicator that the load is approaching the normal, and another plant is started, a small switch places the second machine parallel with the first machine, though one lamp only be placed on the synchronising board. When the phases of the two dynamos correspond, the lamp is steady and bright, but not until then. The second machine is then instantly put in parallel with the first by the insertion of one main switch, and at once takes half the load. The slightest inclination of one plant to get out of pulse with the other throws the majority of the work on the faster engine, and reduces its speed, so that one plant entirely controls the other.

While a great deal of discussion has gone on on the subject of running alternators in parallel, it is, we believe, the claim of the company's engineers that only in the works laid down by them in England is it the regular practice to run in parallel, by which means a great economy in work is effected.

Like the rest of the plant, the switch room exhibits the same advance and embodiment of later improvements as have developed in practice; for instance—

The Lowrie-Hall fault detectors, which formerly were inserted from time to time by means of a test plug to prove whether there was leakage on the mains, are now a permanent part of the switchboard arrangement.

On the switchboard is the "Gay" paralleling device, by which means the plant is efficiently protected should any breakdown of a section of the plant occur.

THE GAY PARALLELING DEVICE.

The main feature of parallel working either continuous or alternating machines to which objection can be taken is the risk of total failure of the supply in the event of an accident occurring to any of the units which are run on the buss bars.

This is a greater danger with high tension generators than with those used for direct supply. The large current capacity of the latter and the lower available E.M.F. prevent the rushes which take place on H.T. machines when any one of a number paralleled gives out. The causes of failure may be due to a fault in the excitation circuit of the alternator magnets, or to a bringing up of the revolving portion by hot bearings, &c. When either of these happens the disabled machine practically short-circuits its neighbour through its armature coils. The fuses of the others of the group are already loaded with the outgoing supply current, and therefore the excess due to the fault at once causes them to blow one after the other, thus completely closing down the station for a time. Mr. Gay has devised a method of arranging the fuses between the dynamos and bus bars as a whole and the various sections of the bus bars, that, in the event of such an accident taking place, the auxiliary fuses which he inserts go before the main cut-outs could act, and instead of the latter being affected they are left to perform their legitimate duty of protecting the individual machines from an excess of current. The auxiliary fuses form the connecting link between parallel and non-parallel running, and when they act the machines are left to continue the supply, running non-parallel. This is a feature which must be very advantageous to all stations which normally adopt the parallel principle of working.

The trenches containing the cables lead into the switch-room at the back of the switchboard, where ample space is provided in which the connections from cables to switches or cross connections on the switchboard can be easily and safely inspected; at the same time it is kept perfectly private except for the proper officials. At the back of the switchboard the connections are all suitably labelled, so that the attendant in charge has always before him a means of tracing them.

The switchboard is designed to deal with three circuits, and is complete with all the necessary instruments for showing current or pressure, for switching exciters on or off and for regulating the voltage, so as to preserve a constant potential at the lamp terminals of the consumer, in accordance with the special regulation on this head made by the Board of Trade.

The test room is provided with Thomson standard voltmeter, Siemens's dynamometers, Wheatstone bridge, Thomson reflecting galvanometer, &c.

The consumers' current is measured by Shallenberger meters.

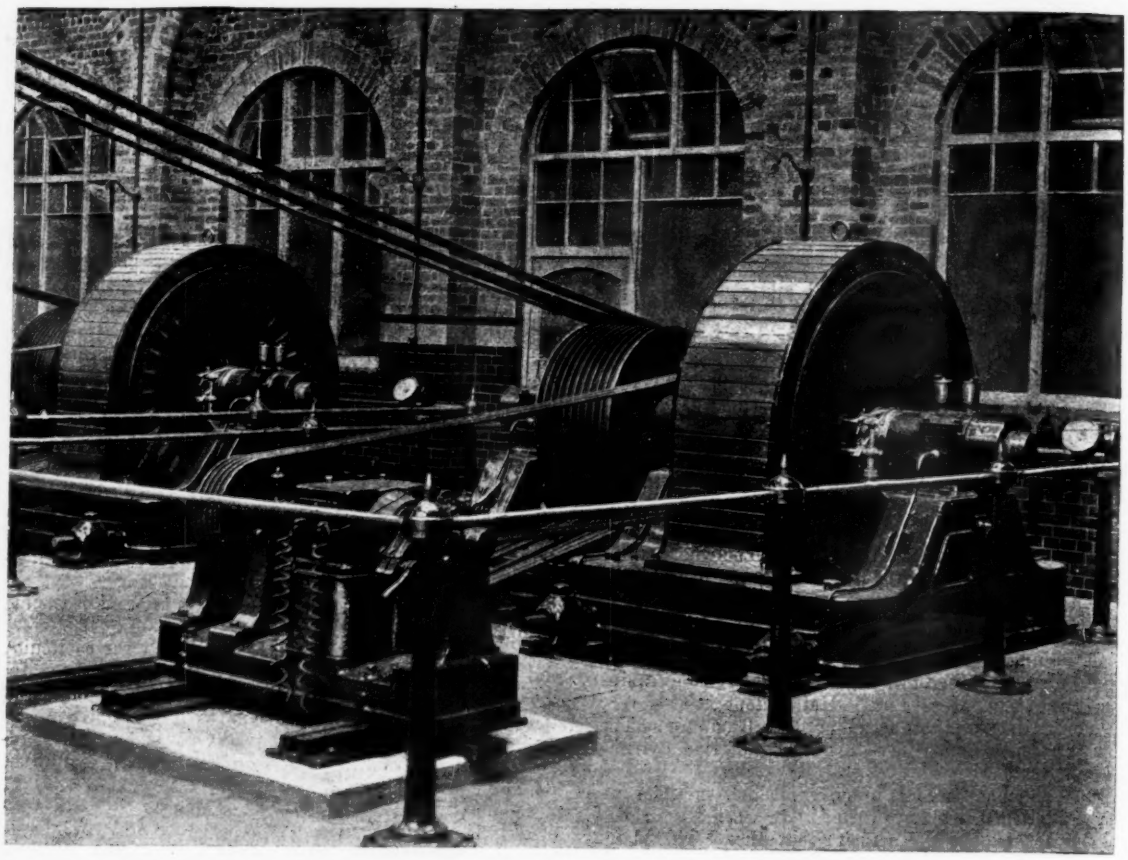
THE SYSTEM OF MAINS.

The Lowrie-Hall system of distribution has been employed, the particulars of which may be stated as follows:—

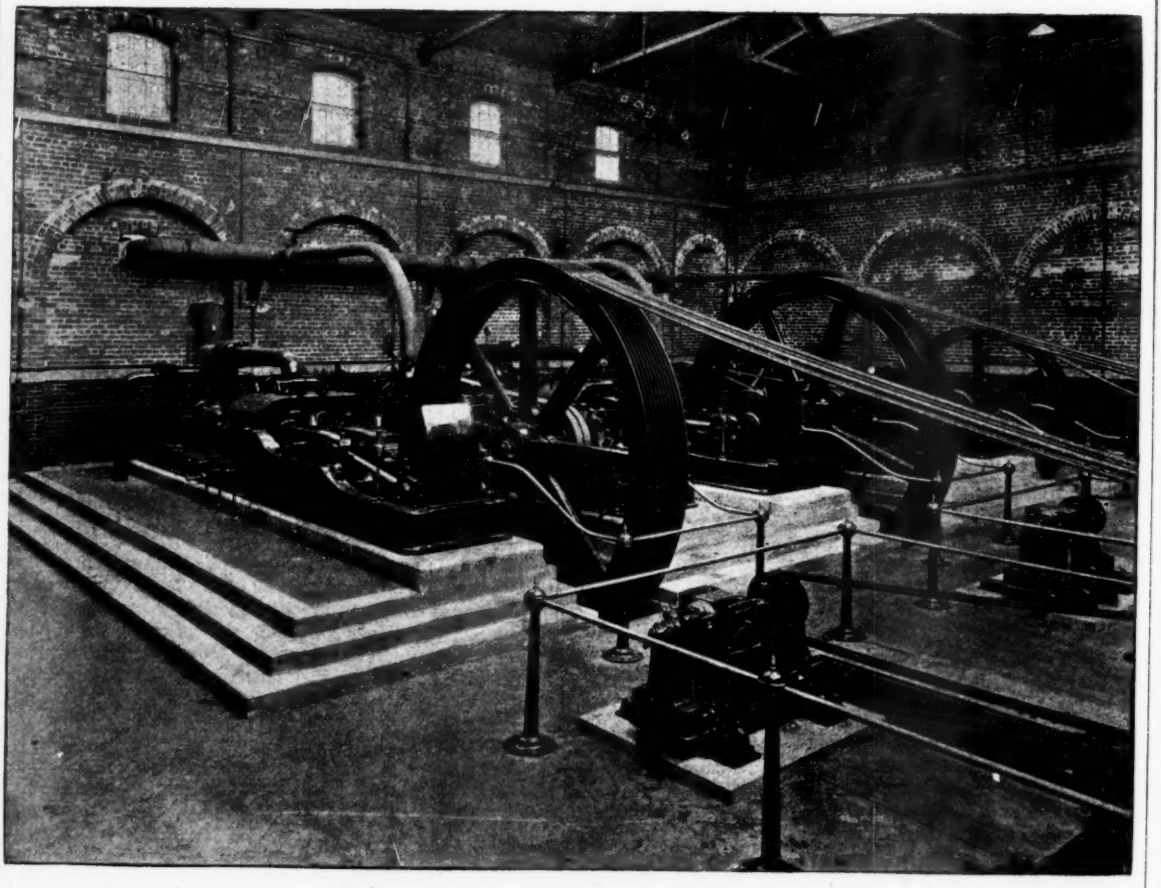
The distribution of electricity generated on the Lowrie-Hall system is effected by means of copper standard cables, insulated with vulcanised India-rubber and laid in a specially-designed system of pipes combined with service and junction boxes.

Each junction box has a loose cover, held in position by a cast-iron clamp (see fig. 1). The culvert connection from the box to the consumer is made by a wrought-iron pipe. The surface boxes, fig. 2, are in all cases placed at the corner of each road, and in the case of a long straight run they would be placed at a distance of about 80 to 100 yards apart. The surface boxes are made in two parts, the bottom part being permanent and the upper part with the cover being adjustable, so as to allow its service to be raised or lowered as the road level may vary, the lid or cover being filled in with wood, macadam, or pavement according to the construction of the road. From the surface box the cable can be drawn in or out where required. Where passing round corners the cable is placed on a revolving drum, which entirely prevents the possibility of abrasion. The largest cable required for the work specified can be laid in half-mile lengths. The jointing of branch cables for consumer's houses is done by cutting away part of the insulation of the main cable, which consists of India-rubber, in the junction or surface boxes, and soldering the copper conductor to the conductor of the branch cable; the joint is then lapped over with rubber the full thickness of the original insulation and vulcanised on the spot, and the cable well-taped and mechanically protected, which makes the insulation of the joint practically equal to that of the cable itself.

The cables of the India-Rubber, Gutta-Percha and Telegraph Works Company are 7/18s, 7/16s, 19/16s, 19/14s, all insulated with pure rubber, then vulcanised rubber of best quality, taped, and the whole vulcanised together, then braided and coated with preservative compound known as Silvertown class L, they are then finally braided over all a second time and covered with preservative



View of the Large Dynamos at Leeds.



View of the Engines at Leeds.

compound. The minimum insulation per mile of these cables is 5,000 megohms, after 24 hours' immersion in water at 60° Fah. and one minute's electrification.

The mains are laid in the following streets:—

Briggate	Park Lane
New Briggate	East Parade
Kirkgate from Briggate to	Bond Street
Boar Lane	Commercial Street
Wellington Street	Park Row
Boar Lane and	Cookridge Street
Infirmary Street	Albion Street
King Street	Lands Lane
York Place	Upperhead Row
Park Square	Woodhouse Lane
St. Paul Street from King Street to Queen Street	Headingley Lane

These streets are comprised within the compulsory area set forth in the provisional order. They have been completed some two or three months within the statutory two years.

With regard to the remaining streets which are within the area of supply, the company is compelled at any time, after the expiration of 18 months from the commencement of the order, to lay down mains in any street within six months upon being requested by requisition to do so, this requisition to be signed by one or more owners or occupiers of premises, or the authority having the control of the public lamps.

THE CONVERTERS.

The converters for reducing the pressure to domestic purposes are of the Lowrie-Hall type, are placed on the consumers' premises in special chambers, or in iron cases, as shown in our illustration (fig. 3). The high pressure wires come

FIG. 3.—CONVERTER IN CASE.

direct on to one side of the converter, and the low pressure is taken direct from the other side through the secondary fuses and the meter into the lamps. The fuses for the moderate size transformers are placed in glass tubes (see fig. 4), which are fixed on the side of the transformers. In the large transformers fuses are placed in porcelain troughs (see fig. 5), which are fitted on to a stout wooden frame fixed to the side of the transformer. The parts of the fuses are shown in the drawings.

TESTS, PRICE PER UNIT, &c.

The completed station was formally handed over to the company by the engineers after exhaustive trials, and commenced regular supply on the mains on May 1st.

The following is a *resumé* of the tests:—

Coal slack consumption 2·45 lbs. per I.H.P. (equal to 1·71 of Welsh steam coal).
Water evaporated 8·6 lbs. per 1 lb. of coal.
Water evaporated per I.H.P. 21·11 lbs.
Electrical efficiency of dynamos 93 per cent.

The switching apparatus worked most satisfactorily, and fully justified the praise bestowed at the private view.

A temporary plant was laid down last year in order to give a supply of electricity to those desiring it before Christmas. This temporary plant has been running since December without a hitch, and consumers have been ex-

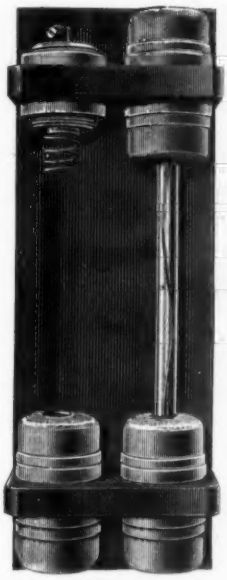


FIG. 4.—TRANSFORMER FUSE IN GLASS TUBE, SHOWING ONE TUBE REMOVED AND TERMINAL CAPS TAKEN OFF.

tremely satisfied with the steadiness and regularity of the supply. The temporary plant could only deal with about 1,000 lights, and therefore many would-be consumers have had to wait until the running of the permanent plant.

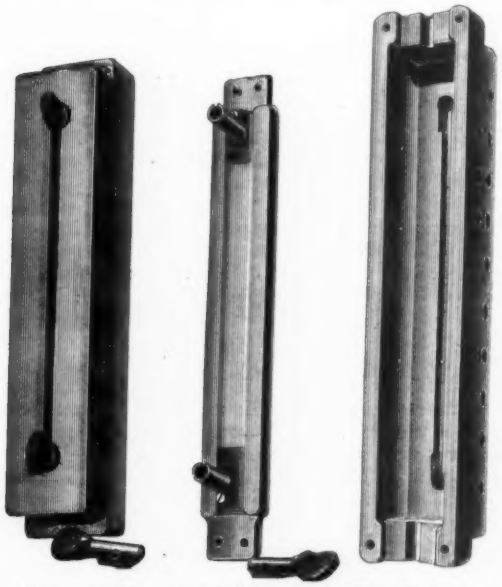


FIG. 5.—SINGLE POLE FUSE FOR LARGE CURRENTS.

The company begins business with 7,000 lights fixed on the circuit, and there is every prospect of these being largely increased. A supply of electricity is now at the disposal of any householders in the above-named streets.

Under the provisional order the rate of charge authorised is 8d. per Board of Trade unit.

The scale of discounts is as follows:—

For not less than 250 hours' use (per quarter) of the maximum supply demanded, 10 per cent.						
"	"	375	"	"	"	15 "
"	"	500	"	"	"	20 "
"	"	600	"	"	"	22½ "
"	"	700	"	"	"	25 "

In addition to the discounts accruing under the above tables, a discount of 5 per cent. will be allowed on the net amount of accounts paid within one month from the date of

rendering, and 2½ per cent. on accounts paid within two months.

The effect of the discounts above mentioned is to reduce the price of 8d. per unit to about the following net charges :—

For 250 hours' use (per quarter)		6¾d.	per unit.
„ 375	„ „	6½d.	„
„ 530	„ „	6d.	„
„ 600	„ „	5¾d.	„
„ 700	„ „	5½d.	„

The whole of the plant has been erected under the supervision of Mr. Robert Hammond, M.I.E.E, the consulting electrical engineer of the company, and the total cost, excluding land, has been about £27,000. Considering the output of the station in effective kilowatts, this seems a rather high sum, and appears to be somewhat in excess of what many other high tension stations have cost. The cost per kilowatt works out to about £108.

The plans for the buildings were prepared by Messrs. Milnes and France, architects, Bradford, and the works were given out as follows :—

Buildings.—Messrs. Gould and Stevenson for mason and joiners' work ; Messrs. J. and H. Smith for iron work ; Mr. Joseph Lindley, Mr. H. Season, Messrs. T. Cordingley and Sons, and Mr. E. W. Walker, for plumbers', slaters', plasterers', and painters' work, respectively.

Generating Plant.—Including engines, boilers, dynamos, switchboard, converters, and all accessories, Messrs. John Fowler and Company (Leeds), Limited.

Meters.—Messrs. The Westinghouse Electric Company, Limited.

Cast-Iron Pipes and Boxes for Street Culverts.—The Stanton Ironworks Company.

India-Rubber Covered Cables.—The India-Rubber and Gutta-Percha Company, Limited.

THE WIRING OF HOUSES FOR THE ELECTRIC LIGHT.

In the columns of *Lightning* of April 20th, attention is drawn in an article entitled, "A Fair Price for House Wiring," to what may be termed the greatest danger to the future of electric lighting, namely, the wiring of houses for the electric light by firms who have nothing to lose, at prices which involve without question either bad work or a large bill for extras, or possibly both. It is not always that the effects of bad wiring show themselves at once; indeed, it is the aim of the jerry wirer to carefully avoid falling into the error of making his profit in such a way as to lead to detection before his bill is settled. The jerry wirer knows quite well in what directions he may legitimately (*sic*) economise, and in what directions it is unwise to do so. It not infrequently happens, therefore, that retribution for the neglect of the laws of electric wiring does not fall upon the guilty party, in the same way that never, within the experience of man, has a jerry-built house been known to fall upon the jerry builder, but on the innocent tenant. The electric wiring trade has to face a very real and potent enemy in cheap and incompetent wiring. The untechnical member of the public is unable to discriminate between good and bad wiring, except by results; it is impossible for him to judge of the probable quality of the work by the price asked, and he cannot be blamed for accepting the lowest tender. It is a very great pity that the public will not understand that the profession of consulting engineer would not exist if it did not have its uses, and that if the untechnical buyer engaged the services of a consulting engineer (in the true sense of the word) when dealing with the technical seller, he would save the expert's fee over and over again in more directions than one. He would have the advantage of knowing that all the estimates were based upon one and the same specification, that such matters as extras would be governed entirely by the degree to which he himself elected to deviate from the specification, that the work would be carried out according to the provisions of the specification and under competent supervision, and that, in case of doubt, difficulty or dispute, he would have the advantage of being represented by an unbiassed expert.

The statements in the article under notice are not exaggerated, and except when dealing with the few firms of undeniable respectability and reputation, the individual who gives the order to wire his house on the strength of the glib representations of the practised tout, is really placing his head in the lion's mouth, figuratively speaking, and giving the contractor a blank signed cheque, practically speaking. A case recently came under the writer's notice where the estimate for "extras" amounted to 150 per cent. of the amount for "wiring." The extras were: fittings, switches, lamps, fuses, wall sockets, lampholders, ceiling roses, and, of course, "man's time and materials." All this more or less unearned increment to the original estimate is very unsatisfactory from the payer's point of view; but there are only two alternatives open to the would-be consumer of electrical energy who does not wish to begin his experience of electric lighting badly, and those are to thoroughly master the subject himself before approaching the contractor, or to employ a qualified professional man to act for him. Unless the customer intends to give his contractor *carte blanche*, and subsequently to write his cheque "with his eyes shut," so to speak, he will find that with the best will in the world, and with the purest and most honest of motives, misunderstandings will arise between himself and the contractor, which always end in bad blood, if not in the Law Courts. The average member of the British, or any other public, does not think it costs the contractor anything to take down and re-run wires and casing half-a-dozen times in each room before deciding upon the final positions of the lights, and thinks himself taken advantage of when the bill for extra work comes in. It has been the writer's experience that saving money in wiring is followed by analogous consequences to those which result from obtaining a reduction on the rent of a house which is to be taken on a long repairing lease. The landlord pleads the concession he has made as an excuse for getting out of doing the many little things which go to make a house really habitable, and by the time the tenant has done these things to his satisfaction, he finds he has spent a sum, the interest on which is about double the saving effected on the rent.

Lightning's correspondent states that "the rough value of, for an average shop or house having, say, from 10 to 60 lights, is 30s. per light." This sum includes everything but *bonâ fide* fittings. It may therefore be taken to include lamps and the wiring of the fittings. Ten to sixty points assuming that no clusters are included in the 60 lights) is rather too wide a range over which to expect the cost to be constant. Let us subtract the value of the constant quantities such as lamps, fuses, switches, ceiling roses, and see what remains out of 30s. for labour, profit, and contingencies. The price of 30s. may be taken to be the price to the customer, and deducting the trade cost of one lamp, one switch, one fuse, and two-thirds of a ceiling rose (thus implying that two-thirds of the lamps are hung by flex from the ceiling), we arrive at about 23s. 6d. for wiring, &c. Deduct 11 per cent. for contingencies, and 21s. remains for labour, wire, casing and capping, and profit. A leading firm of contractors has told the writer that they consider 20s. per light for labour (retail value) a fair price for good workmanship. Assuming 10 per cent. of this to be profit, we have 18s. per light as a fair average value (to the contractor) for labour. Then at 30s. per light, under the above calculations, there is but 3s. left for casing and wire. This is certainly very little, and confirms the writer's experience that except for large installations where wire and material and labour is frequently saved by clusters of lamps, or by lamps being run close together, 30s. per light is a low figure for the best work on the best system. Doubtless exceptional circumstances render exceptional prices possible, but taking the average of house lighting up to 60 lights, 33s. to 35s. would not be too much to pay for wiring (including wiring of fittings but not the fittings themselves), lamps, switches (one to each light), fuses (a double pole fuse on each lamp circuit controlled by one switch). The system and general arrangement should be planned as far as possible before beginning the work, and the construction of the house and the nature of the walls ascertained before any cutting away is commenced. Nothing is so unsatisfactory as to be obliged to alter the run of wires because some unexpected and insur-

mountable obstacle is met with during progress. The best advice any consulting engineer can give his client is to spend money on the wiring and save as much as he likes in simple fittings.

While sympathising thoroughly with the spirit of the whole article, it would not be fair to allow the table of insulation resistance without comment. The article suggests that the insulation on completion should be for

12 lamps	...	...	5	megohms.
25 „	...	...	2·5	„
50 „	...	...	1·5	„
75 „	...	...	1·25	„
100 „	...	...	1·00	„

Now, without wishing to find fault with these figures, we would suggest in fairness to some contractor who may, on a future occasion, be confronted with this table, and be refused payment because an installation of 75 lamps does not show 1·25 megohms insulation resistance to earth, that all such tables as these which are liable to get into the hands of a man who does not understand how to mix brains with rules, should be accompanied by some explanation of what insulation resistance is dependent on. There is perhaps nothing which calls for sounder judgment or more careful consideration than the determination of the value of the degree of insulation resistance as a justifiable ground for the withholding of a certificate for payment to the contractor.

Circumstances may render an insulation resistance of one megohm in an installation of 50 lamps more creditable to the contractor than 1·5 megohm in another installation of 75 lamps. When the installation has to be connected to the supply mains of a company, the company reserve to themselves the right to refuse to supply current to an installation which does not satisfy them as to insulation from earth. But a low degree does not imply negligence, of necessity, on the part of the contractor. The writer was recently asked to give an opinion in a case which bears directly on this point. A suite of rooms had been wired, the contractors had left, and subsequently the supply company came to test. They found so low a degree to earth that they refused to connect. The contractors protested their innocence, and stated that everything was right when they left it. The matter was fortunately cleared up by some one remembering that shortly after the contractors left the people on the next floor had let their bath overflow, and the water had come right through the floor in which the wires had been run. The damp is now gradually evaporating, and the insulation is gaining strength day by day.

It should always be clearly understood between the customer and the contractor, if the light is to be supplied by a company, that the installation must conform in every way to the requirements of the company, irrespective of any existing difficulties, and the contractor would do well to get the Supply Company, or the consulting engineer, to test as soon after completion as possible.

NICETY IN TERMS AND ACCURACY IN DEFINITION.

"CONSIDERATIONS FOR TOWN COUNCILLORS."

MR. N. SCOTT RUSSELL, M.Inst.C.E., has recently compiled some matter to which the above title has been given, and this effusion has been published under the ægis of a contemporary. The attention which is being paid to the mental wants of Town Councillors must be very flattering to them. It is too much to expect from human nature that some return should not be looked for for all the consideration which is being shown towards them. It would be well at the same time to see that such *réchauffé* definitions and terms as is dedicated to their service is above suspicion and, if possible, just a little in touch with modern thought.

We should have been inclined to let well alone, had it not been that the writer, who professedly appeals to men unable to judge for themselves of the correctness of the statements put before them, should at least in the definitive portions of his work, be simple in expression and clear in use of terms. In Mr. Russell's case there are many points which are clearly not as they should be, while the controversial matter has a look which leads one to the conclusion that this is a "novel with a purpose;" if it is not a novel, certainly it partakes of such a nature by being largely fiction. With the conclusion that corporate bodies should undertake their own supply as a general question, there is little to object to, and the preamble may be taken as proven. The first section dealing with "The Law of Electric Lighting" is largely an excerpt from Bower and Webb's well known treatise, and is therefore correct.

Under "Definitions," we are asked to *suppose water to be conveyed in pipes of* 1 *cubic foot area at* 1,000 *lbs. per square foot*. Poor Town Councillors! If they can imagine such a pipe, it is more than our suppositious bump is equal to, and we give it up. Really our ideas of area and volume are sadly lacking in up-to-dateness. Everything now-a-days must be up-to-date, *fin de siècle*, and so on, and no doubt this is an example.

The volt and ampère are solemnly dragged in, and we are told that, having got them, we obtain the power by multiplying them together. It is time that this sort of thing was put out of existence. With the increasing use of periodic currents, surely if it is necessary to give definitions at all, they ought to be made general. In the case of Town Councillors it is difficult to see why such definitions should be brought into the question, for they have nothing to do with the system of electric lighting, and the ordinary business man would get hold of the ideas of pressure and current with greater rapidity, and much more clearly, by working analytically, than as in this case, synthetically.

The actual multiplication is shown very plainly, and but for what follows, might be of use. When, however, we are told "a lamp of 8 C.P. requires about 30 watts per hour," we are inclined to cry out, "Oh! ye shades of Great George Street," and this after Prof. Jamieson, E. Hospitalier, Profs. Ayrton, Thompson, and others have flooded societies and the technical press with papers dealing with definitions, nomenclature, terminology, and so forth.

Side by side stand incandescent lamps and arc lamps. Note the beauty of defining electrical terms for the benefit of our local rulers:—

"The 8 C.P. lamp requires about *30 watts per hour* to light it."	"The arc lamp requires a power of *250 watts* for 1,000 C.P., and *500 watts* for 2,000."
"The pressure most generally fixed is 100 volts."	"The force most generally used is 50 volts per lamp."

The italics are our own. Note the distinction as to volts and volts per lamp, while the assumption the reader is bound to make is that if 30 watts for one hour give 8 C.P., the lamp would require 60 watts to burn two hours, thus confounding a *rate* with a *quantity*, taking activity to be independent of time, which it is not.

A few lines lower down we find the derivation of the Board of Trade unit of supply; and, of course, it is said to be 1,000 watts for one hour. Remembering the above, is it not open for the intelligent municipal potentate to discourse to his friend upon electricity, and calmly state that a watt is one-thousandth of a unit?

This is supported by the statement (*sic*) that 1,000 watts would supply 33 8-C.P. lamps for one hour, or 16 16-C.P. lamps for the same time. What a pity Mr. Scott Russell, did not take a short course at one of the technical schools before writing for the benefit of Town Councillors.

We happen to have known some of this fraternity at various times and in different places, and can assure that gentleman that, being as a class shrewd business men, they are not likely to make use of his "considerations" on finding out the laxity of expression in dealing with terms as to which the slightest ambiguity is apt to cause confusion, leading to arguments which would put Foote's nonsense jumble into the shade.

The question of "systems of distribution" is one on which most writers are apt to be accused of partiality, and it is very difficult indeed to treat the various systems so as to maintain the position of a reviewer of what has been done, without slipping gradually into advocacy of one particular

method. We cannot think that in this case the writer is particularly happy in his ideas, or that those for whom he writes would altogether obtain a grasp of the facts without imbibing a considerable prejudice against direct supply, or, as it has been termed so loosely—the low-pressure system.

We are told that at 1,000 ampères to the square inch of conductor area, *i.e.*, density, the drop is 2½ volts per 100 yards, or 44 volts per mile, approximately. Then the argument follows that :—

Low pressure (direct supply) 100 volts, 44 volts drop per mile = 44 per cent. loss per mile.	High pressure (converted supply) 1,000 volts, 44 volts drop per mile = less than 5 per cent. loss per mile.

So much for comparison. Does Mr. Russell really put it to his readers that low pressure feeders, a mile long, are worked at 1,000 ampères density, or high pressure feeders either for that matter? Minor matters, such as loss in converters, or in low pressure network, may be unmentioned when the main issue is so confused. It must be remembered that discussions on statements of this sort apply only to the feeders of the two systems, whereas the public only care for the net results of the two methods, and not for the relative efficiencies of separate portions.

This gives a wrong impression altogether, especially as later on we are told that low tension can be used if a compact district is to be lighted. Of course this is so, but even there no engineer would think of running his longest feeders at 1,000 ampères density, although the shorter might exceed this considerably. In New York the latter are run at about 1,500 to 1,600 ampères density. After this it does not surprise us to be told that a low tension plant must be *40 per cent. larger* than a high tension one for same lamp factor, and "at full power 40 per cent. more units are made than paid for." Really! But this is not so. If we had not known that 15 per cent. to 20 per cent. was the highest permitted loss, this would have been astounding.

The 3, 4 and 5-wire systems are briefly dismissed, unfortunately without any reference to the extended use of the first, and the leaning to the latter, shown by continental engineers.

The alternate current transformer is stated to be "a C.I. watertight box, containing plates of iron and wire." Does this mean iron plates and iron wire?

An accumulator having previously been defined as consisting "of plates of some metal, usually lead, immersed in dilute sulphuric acid," it seems likely that the layman would assume the A.C. converter to be something of a similar nature.

"In certain low tension systems which have been started, it has been found essential to have three or four separate stations, each with running machinery, and the great economy of one station and one supervision is lost." This looks as if it referred to Liverpool. Now, in that case, a greater economy results from the number of separate stations than, in the opinion of the local company's engineer, would have been the case had they adopted either of the alternatives for that town, a high pressure system, or one station with excessively heavy feeders.

Then gas engine sub-stations are sure to take the place of steam generating stations in many instances, and with this medium of conversion, the success which did not attend the Popp Company in Paris, with their compressed air scheme, seems likely to be obtained.

The comparison of gas and electricity is again made on *cost of lighting to a householder*.

This is *not* the comparison of gas and electricity, but a complex question in domestic economies. Certainly the electric light can be so used by a consumer, that his bills are found to little exceed gas. Supposing gas to be supplied at 3s. per 1,000 cubic feet, and electricity at 6d. per Board of Trade unit, his outlay may be roughly the same; but this is quite apart from the scientific comparison which is indicated by the expression used. This is on a par with gas engine data, which often gives consumption in cubic feet without giving analysis of the gas or thermal units per cubic foot of the same, without which no useful comparison can be made. Surely all illuminating gases are not of the same C.P.? If not, how can a general statement like this go for anything?

With the rest of the information there is little to object to. Much of it is useful and novel in its rendering, but the blemishes which we have pointed out go much further to mar the production than its merits do to recommend it.

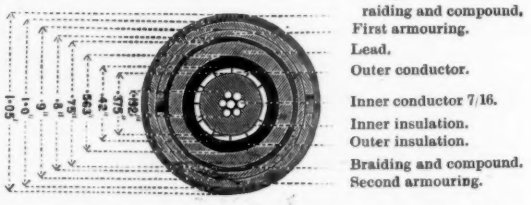
Surely Mr. Russell could produce something a little more conspicuous for accuracy than the present "Considerations for Town Councillors."

THE BRITISH INSULATED WIRE COMPANY.

The manufactory which the British Insulated Wire Company erected a year or two ago, for the manufacture of paper insulated cables, is a good example of the satisfactory work which may be done by an enterprise carried out unostentatiously and on a progressive basis. The future of paper cables seems now to be assured, and it remains not so much to inspire confidence in the system, as to determine what further improvements can be made in a success.

In the paper cable industry, itself, there exist the elements of a sound commercial business; but assurance is, in the case in point, made doubly sure by a combination which enables spare power, plant and buildings (which extend over an area of 60,000 feet), to be further utilised. In this respect the British Insulated Wire Company have done well, as they have conceived the happy idea of utilising a portion of their large works at Prescot for the purpose of an electric light installation. The company appears to be in a peculiarly good position to carry out their project, as the position of their works and the local surroundings are extremely favourable for the works eventually becoming a very large provincial central station for the electric lighting of the surrounding thickly populated district.

The late Lord Derby having expressed his willingness to have Knowsley Hall electrically lighted, the company accordingly put down the plant for a central station at their works. The machinery, which was first erected for the purpose, consists of two Brush alternators of a capacity of 25 units each. These alternators are rope driven by two of Raworth's vertical high-speed engines, which are in their turn supplied with steam from two Lancashire boilers with Galloway tubes (each 30 feet by 7½ feet), by means of steam pipes arranged on the ring system and supplied with valves, so that in the event of any accident occurring to the steam pipes any section can be cut out. Knowsley Hall is situated nearly three miles from the works, and, to connect them, two concentric lead covered armoured mains of the company's manufacture were laid direct in the ground. A diagram is



given of the section of main, and it will be noticed that it is chiefly remarkable for the very small amount of insulation between the inner and outer conductors, the actual thickness being one-tenth of an inch. The pressure at which the current is supplied is 2,000 volts, and it may be doubted whether there is any other firm of cable manufacturers who would care to trust to this thickness of dielectric for the pressure named. These mains have been in continuous use for the last nine months without the slightest fault or trouble of any kind. The pressure is reduced at the Knowsley Hall end by Brush transformers to 100 volts.

There are about 1,000 lamps of 16 C.P. installed at Knowsley, and with this very satisfactory start the company began to consider the advisability of lighting the town. The local board were approached, and an agreement was entered into to light the town of Prescot for five years.

The public lighting consists of 12 Brush arc lamps, of 2,000 C.P., suspended at the corners of the principal streets, and 80 incandescent lamps. The arc lamps are supplied from a Brush arc lighter driven by a horizontal Tangye engine, and are arranged in series, the current being lead thereto by a concentric 7/16 S.W.G. armoured main, laid direct in the ground. The incandescent lamps are also arranged in

series, there being 20 100-volt 16-C.P. incandescent lamps on a 2,000-volt circuit. Brush cut-ins are used, by means of which, in the event of a lamp breaking, another is automatically switched in, in the same lantern.

The mains for these incandescent lamps are merely twin No. 16 S.W.G. wires, lead covered, laid in V-shaped wooden troughs filled in with pitch. We believe that this is the first town in England lighted successfully by incandescent lamps in series, and it certainly goes a long way to solve the problem of lighting a small town economically by means of incandescent lamps.

Provision is also being made to supply private houses with electricity, and a provisional order has been applied for. To this end a 100 I.H.P. compound Browett-Lindley engine and Ferranti alternator, are being put down.

A point in connection with the whole system, is the fact that not only have the company been able to utilise their works to a good advantage, but they have been enabled to submit cables of their own manufacture to more lengthy, severe, and stringent tests than would be possible in ordinary factory testing, and have, consequently, been able to fully demonstrate the utility of their cables.

With reference to the latter, the company claim the following points in connection with the mains :—

Flexibility.

Mechanical strength, owing to their being built up in very thin sections.

That they are lighter and less bulky than any other lead-covered cable in the market.

The company are also making a dry core telephone cable, which was referred to in the REVIEW of May 29th, 1891, as being made by the Norwich Insulated Wire Company. The capacity then attained was ·085 microfarad per mile, but they have now succeeded in reducing this to ·05. The great advantage this gives for telephonic purposes over a G.P. cable having a capacity at least three times as high, is obvious, since it correspondingly increases the distance through which telephonic communication is possible with underground work, the limit with G.P. work being about 40 miles.

There is another point which should be pointed out with reference to paper insulated cables, viz., that the company's experience shows that the measured insulation resistance, as usually taken by the reflecting galvanometer, is of no great value as an indication of the power of the dielectric to resist disruptive discharges, and, therefore, although high insulation is obtained without difficulty, far more importance is attached to the pressure test of from 50 to 100 per cent. over the normal working pressure to which the cables are likely to be subjected; this pressure test is applied to every cable manufactured.

With further reference to the Knowsley and Prescot electric lighting, we should add that the system, as it now exists, has been well carried out under the superintendence of the company's engineer, Mr. Clirehugh, assisted by Mr. Guiseppe.

ELECTRIC LIGHTING OF MALTA.

A FORTHCOMING CONTRACT.

AT the close of 1890, Mr. W. H. Preece drew up a preliminary report concerning the introduction of the electric light in Malta, the works being estimated to cost £40,000, for the supply of 10,000 incandescent lamps. That report has now been supplemented by another, dated Valetta, January 9th last, and in which Mr. Preece gives his conclusions, of which the following is an abstract.

By installing a system of electric lighting, the council of government would not be embarking in a speculation, for they would commence with an income guaranteed by the Imperial War Department and by the Maltese Government, and this assured income is more than sufficient to meet all working expenses, and to pay interest on capital borrowed. The guaranteed income is £2,891 from the War Department, and £4,329 from the Maltese Government. It is estimated that in Valetta alone, from hotels, clubs, offices, shops, restaurants, &c., an income of £2,780, making a total of £10,000, could be immediately secured. Since the previous report, two years' further experience has convinced him that his estimate of £40,000 as the total cost of the installation is over the mark rather than under it. To emphasise this, the following towns, with the capital expended and the number of lamps installed, are mentioned :—

Towns.	Capital expended. £	No. of lamps.
Bradford	42,341	18,000
St. Pancras	80,000	20,000
Brighton	35,377	10,258
Dublin	33,000	10,000
	£190,718	58,258

This gives an average of £3 6s. per lamp, whereas £4 per lamp had been estimated by Mr. Preece. This estimate was complete, and included every possible charge for coal, water, oil, waste, engine stores, administration, supervision, general establishment charges, labour, repairs, maintenance and depreciation. The total working expenses on a plant of 10,000 lamps would amount to £5,380, and allowing an ample margin for interest on capital and for the establishment of a sinking fund to redeem the whole capital in 30 years, there would remain a profit to further the business or to be applied to some useful purpose, such as building schools or improving sanitary arrangements. This profit is, however, not contingent on the success of private lighting. It would be equally true if worked on the guaranteed income alone, which would mean an installation of about 7,000 lamps, the capital expenditure and working expenses being reduced *pro rata*. Mr. Preece urges the council of government to undertake the supply of light rather than transfer their powers to a private company. Private companies mean dearer light. The Government of Malta can borrow money at 3 per cent.; a public company could not raise it at 7 per cent. It is suggested that the Government should charge 7d. per supply unit; this is now the same as gas at 3s. 6d. per thousand, whilst 9d. per unit means 4s. 6d. The Government can thus supply electricity cheaper than gas, but a private company could not compete with gas.

At present, with the exception of the Strada Reale, the streets of the four cities are very badly lighted, and the Government is paying a high price for a poor service. At the same rate the illumination can be improved fourfold by electricity by the Government undertaking the supply; but if a company was to supply current, such a vast improvement would be impossible, except at an enhanced price, for the Government can do it at cost price, while a company must make some profit to pay interest on its greater capital. Mr. Preece urges the council to introduce the light. It would prove an attraction to visitors, for the absence of the electric light has already excited unpleasant comparisons between the hotels of Switzerland, Germany, Italy, and those of Valetta.

Mr. Preece proposes to at once prepare specifications and plans of what is required to be done in the four cities and in Sliema. The plans will be divided into three parts, dealing respectively with (*a*) Valetta and Florian, (*b*) the three cities, and (*c*) Sliema and Hamrun. He strongly urges the council of government themselves to find the capital for the carrying out of the work, although he sees no objection to obtaining terms from a contracting company to work the installation for a period of years. If the Government provide the capital and adopt the suggestions made in the report, they will secure tenders from the most eminent houses in the world; they will attract the dearly-bought experience of the best firms; they will ensure the absolute success of the work, and they will guarantee an expenditure that will not exceed the estimates. If, on the other hand, they invite a company to do the whole work, they may encourage speculation and company promoters; but they will not attract the attention of such strong firms as Siemens Brothers, Crompton & Co., the Brush Company, Ganz & Co., and the Thomson-Houston Company, each of which firms will tender for the work at a fair price, and would maintain the system in working order for a term of years, if the Government are prepared to find the capital, but would not look at the business if they had to provide the capital.

The course to be adopted, therefore, appears to be the following:—(*a*) For the council to decide on adopting the electric light; (*b*) that authority be given to raise capital; (*c*) that specifications and plans be prepared; (*d*) that tenders be invited to instal the work and to maintain it in working order for a term of years; (*e*) that these tenders be carefully examined and compared, and that a report be made on the different proposals, selecting for acceptance the most eligible and the most economical in prime cost and in working expenses; (*f*) the work of installation will have to be thoroughly inspected during progress; (*g*) an experienced and responsible engineer will have to be selected to maintain everything in perfect working order. These conditions can be met, and the installation be in working order by next winter. As already mentioned, the estimated revenue is £10,000, and the total working expenses at £5,380. This leaves £1,200 for interest at 3 per cent. on a capital of £40,000, a sum of £900 as sinking fund at 2¼ per cent., and £2,520 as profit.

LEGAL.

THE GROSVENOR GALLERY ELECTRICAL MACHINERY.

IN the Queen's Bench Division of the High Courts on Friday last, the case of Lindsay *v.* Couper came before Mr. Justice Lawrance and a jury. In this case Sir Coutts Lindsay, Bart., sued Mr. John Couper, a consulting surgeon, residing at 80, Grosvenor Street, W., to recover the sum of £225, being three quarter's rent for the house occupied by defendant under a lease. The defence set up was, that by an agreement dated December, 1887, made between the plaintiff and the London Electric Supply Corporation and the defendant, it

was agreed that so long as there was any interference with the defendant's enjoyment of the house by reason of the working of the engines and machinery of the London Electric Supply Corporation, the defendants should be entitled to deduct from each quarter's rent £75, being the whole amount due under the lease from the plaintiff. The house adjoined the Grosvenor Gallery, and the defendant contended that the noise which was made by the electric light apparatus in the Grosvenor Gallery interfered with his enjoyment of his premises.

Mr. Dickens, Q.C., and Mr. J. W. Chitty, were counsel for the plaintiff; Mr. Winch, Q.C., and Mr. Scrutton represented the defendant.

Mr. JOHN COUPER, the defendant, and his wife and daughter, gave evidence that the humming and buzzing noises occasioned by the electric light machinery in the Grosvenor Gallery was very audible in the drawing room, and was to them a great source of annoyance and discomfort. Mrs. Couper said she was obliged to live in the country the greater part of the year, because she could not bear the noise from these engines. Quiet occupations, such as reading and writing, were almost impossible in certain rooms of their house. The nuisance continued in 1891 and 1892.

Mr. R. APPLEYARD, an electrician, stated that the noise was caused by the transformers. There might be loose parts in the transformers, but an ideal transformer should not have any loose parts.

For the plaintiff, Mr. DICKENS submitted that rent ought to be paid, as the nuisance ceased in 1890, and since that year there had been no interference with the defendant's enjoyment of the house, which would come under the agreement. It was, no doubt, a highly desirable state of things for the defendant to get a house at the corner of Bond Street, where he could see his patients, without paying any rent. The learned counsel went on to ridicule the evidence as to annoyance and nuisance of the noise, and to suggest that the defendant's family had weak nerves and sensitive temperaments so that they could enjoy the house without paying rent. A great deal had been made out of a very little noise, and it would be for the jury to say whether the annoyance was substantial.

The jury found for the defendant.

His lordship gave judgment for the defendant, with costs.

BIRMINGHAM TELEGRAPH FACTORY, LIMITED.

A PETITION presented by Messrs. H. Alabaster, Gatehouse & Co. (proprietors of the ELECTRICAL REVIEW), for the compulsory winding up of the above company, was heard before Judge Chalmers in the Birmingham County Court on 11th inst. The company was formed in 1890 with a nominal capital of £50,000, in £10 shares, of which 701 had been taken and paid up, the shareholders numbering 14. The shareholders, in meeting in February, resolved to voluntarily liquidate. A statement of affairs subsequently issued, showed the liabilities as £7,733, and the assets £5,784, which included no liability on account of shares. Of the 701 shares stated to have been issued by the company, 307, or thereabouts, have not been paid for in cash, or at all. Certain of the shareholders in, and directors of the company, were also shareholders in and directors of Fowler, Lancaster and Company, Limited, and were the holders, in their own names, of a large number of the shares in the Telegraph Factory, which had not been paid for in cash. The petitioners desired, therefore, a full investigation of the company's transactions, and for that purpose petitioned for a compulsory winding-up. In the course of the hearing, it transpired that only seven shares were taken up by the public, Fowler and Lancaster having all the remainder. At the suggestion of the judge, the matter was ultimately adjourned until next bankruptcy day for further affidavits to be filed by Messrs. Fowler and Lancaster, and for them to attend the Court for examination, the petitioners meanwhile to have access to all the books of the company.

FOWLER, LANCASTER AND COMPANY.

IN the Chancery Division of the High Court of Justice, on Wednesday last, the petition of the Electrical Company, of London, for the compulsory winding-up of Fowler, Lancaster and Company, Limited, came before Mr. Justice Williams. The petitioning company are creditors for a debt of £159, due on a dishonoured bill, and they petition for an order for compulsorily winding-up, notwithstanding that voluntary liquidation had been resolved upon.

Mr. Hart appeared in support of the petition; Mr. Farwell, Q.C., appeared for the company, and opposed the petition.

Mr. HART said the hearing had been adjourned in order that fresh evidence might be brought before the Court. Fowler, Lancaster and Company had carried on business at Birmingham, and the company, which was incorporated in 1890, with a nominal capital of £22,000, of which £17,820 was subscribed, was now insolvent, with unsecured trade debts amounting to £6,500, and debentures £7,000. The unsecured creditors thought their interests would not be protected by the voluntary winding-up, and this petition was supported by four creditors for considerable sums.

Mr. JUSTICE WILLIAMS: Eight persons have given notice of opposing, and they are all represented by a debenture holder.

Mr. HART said the company were opposing the petition on the ground that there was nothing to be gained by compulsory winding-up, because the debentures covered the whole of the assets of the company, and, further, that the unsecured creditors would not be prejudiced by the voluntary winding-up. The further evidence given by the company was an affidavit by Mr. Fowler, which did not deal with the point upon which the petitioners based their claim. The petition stated that the assets exceeded the amount of the debentures. It was said now that the total assets only amounted to £8,400, but they were put down at a much higher figure in the balance-sheet issued only last December. He did not suggest that there was fraud in the inception of this company, but he did suggest that the company had gone on trading, and incurred trade debts of £6,500 in two years, while the whole of the assets of the company was in the possession of the vendor in the shape of debentures. The voluntary liquidator, who was the nominee of the shareholders, said that there was no surplus whatever for the trade creditors. That alone showed that there ought to be someone to represent the creditors. The learned counsel contended that the creditors were entitled to an order for compulsory winding-up.

Mr. FARWELL opposed the order.

The case had not finished when the Court rose for the day.

On Thursday, when the case was resumed, a discussion with regard to an arrangement took place, and ultimately the petition stood over generally.

ELECTRIC ARMS AND AMMUNITION SYNDICATE *v.* LUCAS.

LAST Friday, in the Mayor's Court, an action was brought by the Electric Arms and Ammunition Syndicate, Limited, against Mr. W. H. Lucas, a civil engineer, residing at Hammersmith, to recover £42, being calls on shares in the plaintiff company, which the defendant declined to pay, on the ground that there had been misrepresentation in the prospectus issued by plaintiffs. The defendant also claimed to have the register of shareholders rectified by having his name erased, and he also counterclaimed for £100, being the amount he had already subscribed on his shares. It appeared that the defendant subscribed for two £100 shares in the company in 1889. The secretary of the company was called, and explained the operations which had been carried on by the company, including a trial of the weapons at Bisley, and also negotiations with the War Office with the object of getting the authorities to adopt the invention. The defendant, in his evidence, said he complained that it was not true, as alleged in the prospectus, that negotiations were proceeding with foreign Governments to induce them to take the weapons; neither was it true that the invention was perfected; but he had no evidence to produce in support of that view. Upon this the learned Recorder directed the jury that there was no case for the defendant, and a verdict was accordingly given for the plaintiffs, with costs.

WOODHOUSE AND RAWSON UNITED, LIMITED.

IN the High Court of Justice, on Wednesday, four petitions for the compulsory winding up of Woodhouse and Rawson, United, Limited, were heard.

Mr. JUSTICE VAUGHAN WILLIAMS made a compulsory winding-up order on the four petitions. His Lordship, however, said he should not allow the costs of all the petitions. But for the fourth petition a compulsory order would not have been made at all, as all the other petitioners were willing, when the case was previously before the Court, to accept a supervision order. The costs of only the fourth petition, therefore, would be allowed, but two of the petitioners were also entitled to costs. His Lordship was not satisfied that there would not be a surplus to be divided amongst the unsecured creditors. The receiver appointed in a debenture holder's action had stated that the assets were only worth a certain amount, but no one who had seen affidavits made by receivers could have failed to observe that they were apt to underestimate the value of the assets. Debenture holders were often officers, promoters, or vendors, or persons nearly connected with them, whose interest it was to have as little publicity as possible about the winding-up. Here the receiver had not taken into account the large amount which was claimed against the directors. It had been suggested that it was £80,000. It might be that in the case of large concerns an experienced outside liquidator could do more than the Official Receiver could as liquidator, but where a case arose for inquiry it was better to have the intervention of the Official Receiver in a compulsory winding-up. His Lordship, however, intended to make no reflection on Mr. Young, the liquidator, who had given the Court valuable assistance.

ELECTRICAL SUPPLIES AND FITTINGS COMPANY.

ON Wednesday last the case of the Electrical Supplies and Fittings Company, Limited, came before Mr. Justice Williams, in Chancery, on the petition of the Electrical Company, Limited, for the winding-up.

Mr. JUSTICE WILLIAMS ordered the voluntary winding-up to continue under the supervision of the Court.

RE C. J. ALLPORT.

IN the London Bankruptcy Court, on Wednesday last, upon the application of Mr. Radford, a scheme of arrangement was approved under the failure of the debtor, an electrical engineer, and son of the late Sir James Allport, formerly Chairman of the Midland Railway. The statement of affairs shows liabilities to the amount of £14,880, and the scheme provides for payment of the creditors in full.

NOTES.

Heat of the Voltaic Arc.—According to experiments by M. Violle, the temperature of the hottest part of the positive carbon is 3,500° C.

Southampton Electric Lighting.—The Local Government Board have sanctioned the borrowing of £400 for the lighting by electricity of the Southampton Free Library.

Electric Railway for Naples.—An elevated electric railway is projected in Naples by Messrs. Avena and Fantoni, Via Caracciolo Banchina, Palazzo Vilelli-Bartolo, Naples.

A New Metal for Standard Resistances.—An alloy of manganese and copper, in the proportion of 7·9 to 92·0, with traces of iron and silicon, according to Mr. C. E. Guillaume, has as low a temperature coefficient as ·00003 per degree C., the specific resistance of the alloy being 28·8 in microhm-centimetres.

Electric Traction.—In the House of Lords, on 15th inst., the Earl of Morley moved: "That this House do concur in the following resolution communicated by the Commons, namely, 'That a Joint Committee of Lords and Commons be appointed to consider and report whether the grant of statutory powers to use electricity ought to be qualified by any prohibition or restriction as to earth return currents, or by any provisions as to leakage induction or similar matters; and, if so, in what cases and under what conditions; and if the Joint Committee are of opinion that any such prohibition, restriction, or provision should be enforced, to settle the necessary clauses.'" The motion was agreed to.

An Electric Boat Railway in Japan.—The object of this railway is to connect the town of Kiöto (situated on a large river, at the mouth of which is one of the ports open to European commerce), with Lake Bivva, a sheet of water as large as Lake Geneva, and situated 11 miles from the town and 44 metres above the sea. The railway is provided with large trucks on which the boats are placed. Each truck has a dynamo motor which is in constant communication with a central station by means of a metallic cable. The horse-power at the central station is about 500, and is furnished by turbines. About 50 horse-power is used in moving the trucks, which are 3 metres wide, 5 metres long, and 3 metres deep, but which can take boats 7 metres wide and 12 metres long.

The City and Guilds of London Institute.—The report of the Governors of this Institute, which has recently been issued, is satisfactory reading, inasmuch as it points to a steady and continual development of each branch of the Institute's work. The number of day students has been 412 against 382 in the previous session. The number of evening students, viz., 1,500, is practically the same as in the previous year. The number of candidates for the Technological Examinations was 8,534, against 7,416 in the previous year. In the Engineering, Physics, and Chemistry Departments of the Central Institute, the numbers of students attending during the years 1890, 1891, 1892, were 144, 160, and 172 respectively. In regard to the Electrical Department, the Dean reports: "The dynamo room has been partly enlarged and rearranged, and the plant of a model electric lighting station is being erected." At the Electrical Department, Finsbury, the numbers of students during the years 1890, 1891, 1892, have been 99, 100, and 106; the numbers for the evening classes for the two latter years being 138 and 148 respectively. During the past session a course of lectures on "Telephones" was given by the Principal, and attended by 92 persons. A course on "Electric Locomotion," by Mr. A. Reckenzaun, was attended by 97 persons. Mr. G. H. Robertson gave a course of evening lectures on "Secondary Batteries," which was attended by 47 persons. The report on Technological Examinations states that some improvement is shown in the work of candidates in Telegrapy, the number of candidates in the last examination (Telegraphy and Telephony) being 209, with 48·3 per cent. of failures. In Electric Lighting the numbers were 447, with 62·4 per cent. of failures. Electro-Metallurgy shows 33 candidates, with 30·3 per cent. failures.

Redditch Electric Lighting.—An electrical engineer is to be engaged to make plans and specifications for laying down a plant sufficient for supplying the town with electric light. It has also been decided by the Local Board that tenders for the entire work are to be obtained, also particulars as to the probable number of users of the light.

The Institution of Electrical Engineers.—On Thursday next, May 25th, the discussion will be continued "On the Prevention and Control of Sparking; Continuous Current Dynamos without winding on the Field Magnets; and Constant Pressure Dynamos without Series Winding," by W. B. Sayers, Associate.

Howrah Electric Lighting.—Messrs. Martin & Co., in conjunction with Messrs. Burn & Co., are preparing a scheme for lighting the streets of Howrah with electricity at a cost of 2½ lakhs of rupees. The scheme, which embraces the supply of electric light to private residences, will shortly be submitted for the approval of the Municipal Commissioners of Howrah.

Railway Station Electric Lighting.—The electric lighting at the Caledonian Railway Station, Edinburgh, which has been installed by the Brush Electrical Engineering Company, was turned on for the first time on 9th inst. Only 40 lamps are at present lighted, but the full installation will consist of 50 arc and 1,000 incandescent lamps. The result was said to be very satisfactory.

Testimonial.—On Saturday, May 6th, there was a presentation made to Prof. Garnett, at the Durham College of Science, for his winter lectures on "The Pioneers of Electricity." Prof. Ryan (Principal of University College Bristol) delivered an address. The testimonial took the form of two instruments for use in the laboratory—First, a Lord Kelvin's multicellular voltmeter, reading from 60 to 200 volts; Second, a Lord Kelvin's electrostatic voltmeter, reading from 200 to 4,000 volts. Both instruments were manufactured by Messrs. White, of Glasgow, and completely cover the range of pressure usually employed in electric lighting.

Electricity in Mining.—The New Zealand Government have, so we understand, authorised an important inquiry to be made as to the application of electricity as a motive power to gold-saving batteries, the electricity to be generated by the power of a waterfall within a few miles of the Kuaotunu field. There has been considerable difficulty in saving the gold from the Kuaotunu (Coromandel) ores, owing to the cost involved in working the batteries. Some time since representation was made to the governor of the cost of taking coal and other material on to the field for treating these ores. A suggestion was also made that electricity generated by water power at the falls, some eight miles distant, could be used as a motive power for battery purposes. The ore is low grade. According to the *New Zealand Herald*, the Government have decided to send Mr. Fletcher, electrical engineer, Otago, and Mr. Gordon, inspector of mines, to report as to what can be done in the matter.

The Metric System of Measurement.—Messrs. Willans and Robinson, of Thames Ditton, Surrey, have now adopted the metric measures in their works. They have adopted this course owing to the practical convenience of the metric system, and to their conviction that they thus obtain commercial advantages in securing orders in those countries where the metric system is in force, and in order that parts of engines made by them may be interchangeable with those made by their licensees abroad. We are authorised to state that their existing standard sizes of engines, chiefly used for non-condensing purposes, will remain unaltered, in order, among other reasons, to avoid causing inconvenience to present users of their engines, the gauges, templets, &c., only, for the sake of uniformity in the works being re-stamped to the nearest hundredth of a millimetre. A new series of engines, however, specially designed for condensing work which is now in hand, and all new works will be constructed to even measurements on the metric system. Mr. Charles Louis Hett, of the Turbine Foundry, Brigg, contemplates adopting this system of measurement in his works also.

Ealing Electric Lighting.—Application is to be made to the Local Government Board for power to borrow £25,000.

Aberystwyth Electric Lighting.—A special committee meeting of the whole council has been held to discuss Prof. Garnett's report on electric lighting.

Wakefield Electric Lighting.—The Electric Lighting Committee formed at the commencement of the year have got together a good deal of information, and the Corporation have now decided to apply for a provisional order.

Technical Instruction.—The Shoreditch Vestry have sanctioned the appointment of Mr. A. M. Sillar, A.M.I.E.E., as instructor of the electrical fitting class at the technical schools.

Blackburn Electric Lighting.—The Town Council have selected Mr. Thomas to serve as electrical engineer during the installation of the electric light in the centre of the town. The appointment is not a permanent one.

Nottingham Electric Lighting.—A Local Government enquiry was held at Nottingham last week regarding the Corporation's application to borrow £45,000 for electric lighting purposes.

A New Alternating Current Motor.—An alternating current motor, of a new type, made by Messrs. Brown, Boveri & Co., of Baden (Switzerland), has just been tested at Frankfort-on-the-Maine.

The Royal Society.—The following paper was down for reading yesterday afternoon before the Royal Society :—"A Further Minute Analysis by Electric Stimulation of the so-called Motor Region of the Cortex Cerebri in the Monkey," by Dr. Beevor and Prof. Horsley, F.R.S.

Erratum.—In the article by Mr. Camillo Olivetti, on "The Starting of Synchronous Alternators," in our last issue, an error occurred on p. 555, second column, line 15 ; instead of "speed between $\frac{f}{2}$ and p," read "speed between $\frac{f}{2}$ and f."

The Eastern Telegraph Company.—A correspondent informs us that Mr. J. Denison Pender, son of Sir John Pender, has been elected managing director of the Eastern Telegraph Company, in place of the late Sir James Anderson.

The Sir John Pender Gold Medal.—This Medal has just been awarded to Mr. David A. Ramsay, as the best diploma student in Prof. Jamieson's Electrical Engineering Laboratory at the Glasgow and West of Scotland Technical College.

The Late Sir James Anderson.—A correspondent writes :—"In the obituary of Sir James Anderson, I note the remark : 'His superintendence of the expeditions for laying the Atlantic cables of 1865 and 1866.' This will have a tendency to perpetuate the error which a good many fall into with regard to Sir J. Anderson. Those expeditions were entirely under the charge and direction of Samuel Canning, assisted by Henry Clifford, the whole of the arrangements having been thought out and worked out by them, and finally carried out by them, with the able and valuable assistance of Willoughby Smith, De Sauty, and others. Mr. James Anderson, of the Cunard Company, whose services were kindly allowed by them, took charge of the *Great Eastern*, with Captain Robert Halpin as chief officer. The navigation of the ship throughout the expedition was entrusted to Captain Moriarty, R.N. Both Canning and Clifford are modest, and are satisfied with the knowledge of having successfully accomplished their work. But without wishing to detract in any way from what Sir James Anderson did *subsequently* to 1866 to further the success of submarine telegraphy, I think that the credit of these two great expeditions should be given to those to whom it is due —to Sir Samuel Canning and Henry Clifford, whom, I am glad to say, are still alive and amongst us. The list of those who were on board the *Great Eastern* has been very much reduced of late."

Killin Electric Lighting.—There is a proposal afoot for lighting the town with the electric light.

Shrewsbury Electric Lighting.—The Town Council have decided to consider the question of electric lighting the streets.

Southport Electric Lighting.—The question of what was the best system to adopt for lighting the town by electricity having been submitted to Mr. E. Manville, he has presented an exhaustive report on the subject, in which he recommends the alternate current transformer system.

Taunton Electric Lighting.—A Bill, enabling the Corporation of Taunton to supply electricity within the borough, and a portion of the district of the Taunton Rural Sanitary Authority, came before the Examiner of the House of Commons last week. There was no opposition at this stage, and the necessary formal proofs having been given, the Bill was ordered to be reported for second reading.

Austro-Hungarian National Exhibition, 1896.—A Note has been received by the Department of Science and Art, through the Foreign Office, from the Austro-Hungarian Ambassador at the Court of St. James's, announcing that a National Exhibition will be held at Budapest in 1896, commemorating the 1,000th anniversary of the foundation of Hungary.

From St. Paul's to the Highlands and Back.—This is the title of a brochure in the form of a descriptive letter published by the Aberdeen Steam Navigation Company, which will doubtless be read with interest by Londoners who are making arrangements for their summer holidays. It is attractively got up, and the detailed letterpress description of the tour is accompanied by some excellent illustrations. We would suggest that our readers should apply for a copy, for whether they take the trip or not, they cannot fail to become interested in both the Steamship Company and the Highlands.

Electric Lighting Bills in Parliament.—The Unopposed Bill Committee of the House of Commons, presided over by the Chairman of Ways and Means, on Tuesday passed a Bill which confirms provisional orders that have been granted by the Board of Trade to the Vestry of Hammersmith and the District Boards for Hackney and Poplar, with power to these authorities to light their respective areas with the electric light.

There was also one enabling the Local Board of Bridgend to supply electricity within the area of their authority. This was likewise ordered to be reported for second reading.

The Electric Light on Saxony Railways.—The managers of the Saxon railways have decided to light the whole of the Dresden stations by electricity, and also to supply them with motor power. The estimate adopted is that of the Siemens firm, which provides for one central station of 1,300 horse-power, in which tri-phased currents of 120 volts will be produced. The tension will be raised to 3,000 volts at the station itself, and reduced again at the place where it is used. The length of the network is 6·5 kilometres, and 600 incandescent lamps are provided for.

Elmore's Companies.—According to a letter which appeared in the *Financial News* of last Monday, from the pen of "A Shareholder," the creditors of the Elmore Wire Company, have put in the bailiffs. This, it appears, has been done since last Friday's meeting of the Patent Company. The shareholder to whose letter we refer recommends liquidation, notwithstanding the efforts that are being made to get fresh capital, as the £17,600 worth of preference shares offered will not, he says, be sufficient to keep the company going under the altered circumstances.

In the *Financial News*, of Wednesday last, we observe the following : "The Elmore Patent Copper Depositing Company is to have one more chance of fulfilling its promises. The whole of the new preference shares are stated to have been subscribed—which, in these times, is simply wonderful—and the company, it is to be hoped, will be able at last to prove that the patents can be successfully worked on a commercial scale."

Lewes Municipal Buildings Electric Lighting.—The Town Hall and Brassey Institute are to be lighted by electricity.

Dundee and North of Scotland Institute of Mechanical Engineers.—Last Monday the members of this Institute visited the Electric Light Station, Dundee.

The English Telegraph System.—Mr. Henniker Heaton was to move in the House, yesterday, for the appointment of a Select Committee to enquire into the State expenditure upon telegraphs, the charges levied, and the best methods of making the income cover the expenditure.

Coast Communication.—Mr. J. Lowther gave notice in the House of Commons last Monday, that in Committee of Supply he would call attention to the report of the Royal Commission regarding electrical communications with lighthouses, and move a reduction of the Vote.

Cheap Traction or Defective Telephones.—We have received a copy of an article signed by Messrs. R. E. Crompton, E. Garcke, and Sydney Morse, entitled, "Cheap Traction or Defective Telephones." With this we hope to deal fully in our next issue.

Halifax Electric Lighting.—Application is to be made to the Local Government Board for power to borrow £30,000 for electrically lighting the borough. The electrical engineer has been instructed to prepare plans, estimates and specifications for the scheme.

Hove Town Hall Electric Lighting.—It is being considered whether the Town Hall and Municipal Offices shall be lighted by electricity. The Town Hall Committee have resolved to recommend the Commissioners to apply for power to borrow £1,400 to meet the cost of the work.

West Calder Electric Lighting.—A movement has been in progress for some time to improve the public lighting. A deputation laid a proposal before the committee of the West Calder Co-operative Society that they would pay for the erecting of arc lamps throughout the streets, if the Society gave the electric current from their dynamo free of charge. The Society have agreed to this proposal, and steps will at once be taken to erect the lamps.

Tramway Competition.—The Halle Tramway Company have decided to substitute electric traction for horse haulage. This step is necessitated by the competition of the existing electric tramline, and by the demand of the public for electric cars. Five offers have been sent in, and one has been accepted.

Lectures.—A paper was read by Mr. John Rochford, C.E., at the general meeting of the Institute of Civil Engineers, Dublin, some days ago, on "Electrical Communication between Light Vessels, Rock Stations, and the Mainland.

A lecture was, the week before last, delivered in the Marine Engineers Institute, The Arcade, Sunderland, by Mr. Walter H. Flood, on "Electricity on Shipboard and its Management."

At the closing meeting of the session of the Glasgow Philosophical Society in Glasgow last week, Dr. J. T. Bottomley lectured on three subjects as follows: "Vacuum Tubes without Electrodes;" "Some Results of Instantaneous Photography," and "Apparatus for Testing the Insulation of Electric Light Wires."

On Tuesday, May 30th, Mr. Swinburne will deliver the first of a series of lectures on "The Design and Construction of Dynamo Machines and Transformers" to the students of the Electrical Standardising, Testing and Training Institution at Faraday House.

A scientific exhibition by Mr. J. Jerritt was given in Plymouth on Wednesday last. A lecture, reproduced by Edison's phonograph, was delivered on electricity. A large model electric railway, powerful electro-magnets which held up several hundredweights, and some very large vacuum tubes were exhibited. Specimens of the various instruments in use in the British Postal Telegraphs were shown and described by Mr. Jerritt. The experiments were all successfully performed.

Electric and Magnetic Plasters.—The result of the recent legal suits do not seem to deter adventurous persons from trying to catch a few of the crumbs which fall from the rich man's table. A circular emanating from 101, Piccadilly, Manchester, has reached us, in which a proposition is put forward for starting "The Electro-Magnetic Medical Plaster Company, Limited," to purchase the invention, patent rights, &c. (Patent No. 7,617, April 14th, 1893), and to manufacture and sell the articles referred to therein. William Wise and Henry Mills, inventors and patentees, who sign the circular state: "The patent secures to us the sole right to apply electricity or magnetism by means of medical plasters for curative purposes." They are to be sold *like other porous plasters* at 1s. 1½d. and 2s. 9d. each, and "there will be found to be more efficacy in one of these plasters than in most of the belts and appliances for which two guineas and upwards is regularly charged." The signatories so firmly believe in the immediate success of the proposed company, that they agree to take payment for their interest entirely in shares, and further, to take no dividend until all other shareholders have received at least 10 per cent. Messrs. Wise and Mills must be new to the business, or they would know that electric and magnetic plasters are very old friends; therefore we fear patent No. 7,617 will need considerable alteration and amendment before its claims will hold good. In the meantime would-be investors should peruse certain back numbers of the ELECTRICAL REVIEW, and the probability is that the "Electro-Magnetic Medical Plaster Company, Limited," will get no further than the circular.

NEW COMPANIES REGISTERED.

Aladdin Primary Electric Battery Company, Limited (38,739).—This company was registered on the 28th ult. with a capital of £6,000 in £10 shares, to acquire by purchase the patent rights of Messrs. T. Coad, of and in a primary electric battery and electric miner's safety lamp, and to carry on the business of an electric light company in all its branches. The subscribers (with one share each) are:—T. Coad, The Laurels, West Green Road, Tottenham, electrician; A. Saunders, 21, Great St. Helen's, E.C., solicitor; H. Bruner, Gipsy Hill, S.E., merchant; P. M. Mountain, West Dulwich, S.E., merchant; J. Walton, Tulse Hill, S.E., merchant; W. Hope, Wimbledon, secretary; H. S. Mountain, West Norwood, salesman. The regulations of Table "A" apply in most cases. Registered by Stokes, Saunders and Stokes, 21, Great St. Helen's, E.C.

Rainbow Engineering Company, Limited (38,762).—This company was registered on the 1st inst., with a capital of £20,000 in £5 shares, to acquire the goodwill of the business carried on at Albany Buildings, 39, Victoria Street, S.W., under the style or firm of "The Rainbow Engineering Company;" to enter into an agreement made between C. H. Rosher and J. C. Goodenough, and to carry on the business of electrical engineers and all similar trades. The subscribers (with 1 share each) are:—J. C. Goodenough, Bromley, Kent, clerk; W. H. M. Knox, 29, Chapter Road, S.E., architect; J. E. Boaz, 18, Leopold Street, E., engineer; P. W. Rosher, Ryde, Isle of Wight, accountant; C. H. Ewen, 184, St. George's Street, E., engineer; J. Theodore Barker, Croydon, architect; W. Buckley, Croydon, gentleman. Registered, without articles of association, by J. B. Purchase, 11, Queen Victoria Street, E.C.

Electric Light Regulating Syndicate Limited (38,705).—This company was registered on the 25th inst. with a capital of £1,000 in £1 shares, to enter into an agreement between E. P. Davis and A. C. Collins, and to carry on the business of electricians, mechanical engineers and suppliers of electricity for the purposes of light, heat, and motive power. The subscribers are:—F. Davis, 24, Park Crescent, W., Esq., 100 shares; P. Leney, 81, Broadhurst Gardens, N.W., gentleman, 5 shares; Jno. Davis, Temple, barrister-at-law, 5 shares; E. Davis, Portland Place, W., 1 share; L. A. Green, 135, West End Lane, N.W., gentleman, 1 share; F. Samuelson, 8, Broad Street Avenue, E.C., solicitor, 1 share; E. P. Davis, 8, Broad Street.

Avenue, E.C., solicitor, 1 share. The rules of Table A apply. Registered office, 8, Broad Street Avenue, E.C.

West Hampstead Foundry and Engineering Company, Limited (38,815).—This company was registered on the 9th inst. with a capital of £15,000 in £1 shares, to acquire and take over as a going concern the business of mechanical and electrical engineers, ironfounders, boiler makers, manufacturers of locks and safes, now carried on at West Hampstead and known as the Hampstead Foundry; to enter into an agreement for that purpose; to purchase patents, &c.; and to continue the businesses above mentioned. The subscribers (with 1 share each) are:—L. H. Radley, 30, Foxgrove Road, Beckenham, Kent; W. G. Sharp, commission agent, 8, Cloudesley Street, N.; E. Parkes, managing clerk, Stoke Newington; J. C. Bardili, managing clerk, Leyton; D. B. T. Paterson, clerk, 138, Leadenhall Street, E.C.; E. W. Edward, ironmonger, East Ham; B. S. Dunn, accountant's clerk, Forest Gate. The number of directors is not to be less than three nor more than eight; qualification, £100; remuneration, £50 per annum, and any other sum the shareholders decide upon in general meeting. Registered by W. H. Dunn, A.C.A., 93A, Ethelburga House, E.C.

The Bourne and Grant Electricity Supply Company, Limited (38,854).—This company was registered on the 13th inst. with a capital of £25,000 in 24,900 ordinary and 100 founders' of £1 each, to carry on the business of an electric light company in all its branches, and, in particular, to lay down, fix and carry out all necessary cables, wires, lines, accumulators, lamps, and works, and to generate, accumulate, distribute and supply electricity, and to follow the trades of electricians and mechanical engineers. The subscribers (with 1 share each) are:—J. Bourne, gentleman, Hilderstone Hall, Stone; A. H. Jones, 38, Inverness Terrace, Bayswater; F. Levick, merchant, Cornhill Chambers, E.C.; F. Walters, merchant, 12, Tokenhouse Yard, E.C.; T. Witt, public accountant, 40, Chancery Lane; A. H. Morgan, merchant, 22, Selborne Road, N.; T. B. Grant, engineer, 15, George Street, E.C. The number of directors is not to be less than three; qualification £100; remuneration £50 per annum, and percentage. Registered office: 15, George Street, E.C.

Coventry Electric Tramways, Limited (38,821).—This company was registered on the 10th inst. with a capital of £25,000 in £5 shares, to acquire railways, tramways, and roads in the United Kingdom; to apply for working powers; to adopt an agreement made on the 5th inst. between the Electric and General Contract Corporation, Limited, and A. G. Jones; to construct railways and tramways; to promote electric and other works, and to equip and work with electric, steam, mechanical, animal, or other motive power, the railways, &c., of the company. The subscribers (with one share each) are: H. L. Fletcher, civil engineer, 35, Parliament Street, S.W.; E. L. Brown, stenographer, 35, Parliament Street, S.W.; Wm. Lambert, solicitor's clerk, 35, Parliament Street, S.W.; S. P. W. D'Alte Sellon, Esq., 35, Parliament Street, S.W.; F. W. Ketley, electrician, 17B, Great George Street, S.W.; H. G. Burgess, solicitor's clerk, 19, Parliament Street, S.W.; H. W. Stutfield, solicitor, 49, Parliament Street, S.W.: Most of the rules of Table A apply. Registered by R. Byron Johnson, 49—50, Parliament Street, S.W.

Saxby & Farmer, Limited (38,786).—This company was registered on the 4th inst. with a capital of £25,000 in £10 shares, to adopt an agreement made on the 21st ult. between R. Plumbe and C. Hodgson, executors of the late J. S. Farmer, who carried on the business as Saxby & Farmer, and C. G. Hodgson, and to carry on the business of electricians, mechanical engineers, manufacturers of railway signals, locking apparatus and safety appliances. The subscribers (with 1 share each) are:—C. Hodgson, engineer, Glyndhurst, Cricklewood, N.W.; C. G. Hodgson, engineer, Glyndhurst, Cricklewood, N.W.; G. S. Bakshall, book-keeper, Brondesbury, N.W.; W. R. Mott, clerk, Kilburn, N.W.; P. Black, draughtsman, Kilburn, N.W.; C. Hills, draughtsman, 18, Wyndham Road, N.W.; W. C. Acfield, draughtsman, West Hampstead, N.W. The number of directors is not to exceed five, unless determined to the contrary, and the first members of the board are:—C. Farmer, C. Hodgson, and A. J. Constable; qualification £100; Remuneration, C. Farmer, £200 per annum. C. Hodgson (while he continues managing director), £1,500 per annum and 10 per cent. of the net profits of the company. Registered by Faithful & Owen, 11, Victoria Street, S.W.

St. Nicholas Construction Company, Limited (38,768).—This company was registered on the 2nd inst. with a capital of £40,000 (or francs, 1,000,000), divided into 2,000 shares of £20 each (or francs, 500 each), to establish the business of mechanical and electrical engineers, and to carry on as the directors may think fit, as principals or agents, the manufacture and sale of electric, telegraphic, surgical, and scientific instruments and appliances. The subscribers (with 1 share each) are:—J. Woods, paper stainer manufacturer, High Barnet; W. A. Kirkwood, engineer, 2, Wilson Street, W.C.; W. Routledge, engineer, 49, Trinity Square, S.E.; H. W. Andrew, clerk, Hornsey, N.; A. Kent, salesman, Leyton, E.; A. St. Vincent Schrader, cashier, 11, Huddleston Road, N.; H. Butters, clerk, High Barnet, N. The rules of Table A apply in most instances. Registered by G. D. Freeman, 163, Paul Street, E.C.

Rollason's Wind Motor Company, Limited.—This company was registered on the 5th inst. with a capital of £35,000 in £1 shares, 350 of which are founders' and the remainder ordinary—to carry on the business of electricians and mechanical engineers, suppliers of electricity for the purpose of light, heat, motive power or otherwise, and manufacturers and dealers in all apparatus and things required for or capable of being used in connection with the generation, supply, accumulation, and employment of electricity. The subscribers (with 1 share each) are:—G. R. Rollason, engineer, 50, Goldhurst Terrace, N.W.; C. A. Rollason, engineer, 50, Goldhurst Terrace, N.W.; B. Maltby, accountant, 13, Melbourne Terrace; J. D. Harrison, solicitor, 29, Kingdon Road, N.W.; G. Russell, stationer, 85, Chancery Lane, W.C.; J. T. Lacey, contractor, 336, City Road, E.C.; P. S. White, solicitor, 131, Lordship Road, N. The number of directors is not to be less than 3 nor more than 7; qualification, 100 ordinary shares; remuneration, chairman, £150 per annum; ordinary directors, £100 per annum and percentage of profits. Registered office: Nos. 3 and 4, Great Winchester Street, E.C.

Colne Engineering Company, Limited (38,793).—This company was registered on the 5th inst. with a capital of £10,000 in £1 shares; to adopt an agreement made on 24th ult. between E. G. M. Donnethorne and B. Baker, for the purchase of the business heretofore carried on at Twickenham under the style of the "Colne Engineering Company," and to carry on the business of electrical, gas, and mechanical engineers. The subscribers (with one share each) are:—B. Baker, engineer, 15, Great George Street, S.W.; R. Wilson, engineer, 117, Charterhouse Street, E.C.; W. G. Logan, accountant, Surrey House, W.C.; E. Smiles, gentleman, Surrey House, W.C.; F. Grant, chartered accountant, 72, Bishopsgate Street, E.C.: C. G. Wood, gentleman, 151, Ball's Pond Road, N.; J. H. Shipway, engineer, 32, Crewen Street, W.C. The greater part of the regulations of Table A apply. Registered by B. Baker, 15, Great George Street, Westminster, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electricity Supply Company for Spain, Limited.—The annual return of this concern, made up to the 12th of January, has just been filed, and shows that the whole of the nominal capital of £100,000, in 19,900 ordinary and 100 founders' shares of £5 each, has been taken up. The founders' shares were issued as fully-paid, and the sum of the ordinary shares has been called and remitted.

Edison-Bell Phonograph Corporation, Limited.—The statutory return of this company has been made up to the 6th inst., and shows that out of a capital of £60,000, in £5 shares, all the shares have been taken up. The amount of calls received is £22,985; £20,000 has been considered as paid, and £5,015 is in arrears.

Electrical Advertising Syndicate, Limited.—The annual return of this company has been lately filed at Somerset House, and shows that out of a nominal capital of

£10,000, 907 shares of £10 each have been taken up. The full amount has been paid, and all calls, reaching £9,070 paid. The registered office is now at 11, King William Street, E.C.

Electric and General Contract Corporation, Limited.—The statutory return of this company has been made up to March 31st, and discloses the fact that out of a nominal capital of £50,000 in 9,000 preference and 1,000 deferred shares of £5 each, 805 preference and 1,000 deferred shares have been taken up, 799 of the latter having been issued as fully paid. The full amounts have been called on the remaining shares of both classes, and £5,030 has been paid.

Fareham Electric Light Company, Limited.—The annual return of this company has been made up to March 30th last. The nominal capital is £5,000, in £1 shares, of which 4,158 have been taken up. The full amount has been called upon these. There is £4 still unpaid.

Edison-Gower Bell Telephone Company of Europe, Limited.—The annual return of the above concern was filed on the 14th ult. at Somerset House, and shows that out of a capital of £500,000 in £1 shares, 385,009 were taken up, 370,000 of which were issued as fully paid. The full sum has been called and paid on the remaining shares.

Elieson Accumulator (British Patent) Syndicate, Limited.—The annual return of this company has lately been filed, from which it appears that 2,007 shares have been called up out of a capital of £12,000 in £1 shares. A call of 10s. has been made. The calls paid amount to £103 10s., while those unpaid reach £900.

Electric Stores Company, Limited.—The annual return of this company has been filed at Somerset House, and from this, it appears, that only seven shares have been taken up out of a capital of £15,000 in an equal number of shares. Nothing has been called up.

Telephone Company of Egypt, Limited.—The annual return of this company was made up to the 19th ult., and shows that out of the nominal capital of £100,000 in 16,000 preference and 4,000 deferred shares of £5 each, 12,071 preferred and 4,000 deferred shares have been taken up. The full amounts have been called on the former class, and all calls paid. There were 71 preference shares issued, as "agreed to be considered as paid."

Johannesburg Lighting Company, Limited.—The annual return of this company has lately been presented at Somerset House. It discloses the fact that out of a capital of £150,000 in 50,000 preference and 100,000 ordinary shares of £1 each; 50,000 preference and 77,132 ordinary have been taken up, of which the preference and 77,125 of the ordinary were issued as fully paid.

Keswick Electric Light Company, Limited.—The annual return of this company was lately filed at Somerset House, and shows that out of a capital of £5,000 in £1 shares, 3,420 shares have been taken up. The full amounts have been called and all calls paid.

New Telephone Company, Limited.—The annual return of this company was made up on the 14th ult., and shows that out of a share capital of £750,000 in 74,700 £10 shares and 3,000 £1, 74,695 and 3,000 have been paid up. There has been £10 called on 1,000, £4 on 73,200, and £1 on 3,000. The total amount of calls received is £304,736, and that remaining unpaid is £1,064. A sum of £5,000 has agreed to be considered as paid, and £10 has been forfeited on five shares.

Leeds and London Electrical Engineering Company, Limited.—The annual return of this company has been made, and shows that out of a capital of £100,000 in 250 founders', 9,750 preference, and 10,000 ordinary shares, all of £5 each, 992 shares have been taken up, of which £5 has been called on 250 founders' and 634 preference shares, £1 on 100 preference and £5 on 8 ordinary shares. The total amount of calls received is £4,530, and £30 yet remains unpaid.

Notting Hill Electric Lighting Company, Limited.—The annual return of this company was made on the 10th ult., and shows that out of a nominal capital of £100,000, in 6,452 ordinary, 550 founders', and 2,998 ordinary preference shares of £10 each; all the ordinary, founders', and 816 of the ordinary preference shares have been taken up. The full amounts have been called, and all calls paid.

Thompson, Ritchie & Company, Limited.—The annual return of this company made up to the 13th ult., has been lately filed, and shows that out of a nominal capital of £5,000 in 200 preference and 300 ordinary shares of £10 each, all the preference and 140 of the ordinary shares have been taken up, of which 100 preference and 70 ordinary shares have been issued as fully paid. The full amounts have been called on the remaining 100 preference and 70 ordinary shares, and all these calls have been paid.

India-Rubber, Gutta-Percha and Telegraph Works, Limited.—The annual return of this company was made up not long ago, and shows that out of a capital of £812,000, £500,000 in £10 shares has been taken up. The full amounts have been paid.

Dick, Kerr & Company, Limited.—The annual return of this company has just been made, and shows that the whole of the original capital of £160,000 in £5 shares has been taken up.

CONTRACTS OPEN.

Ealing—May 30th. Tenders are wanted by the Urban Sanitary Authority for the construction of electric light machinery and accessories. Plans may be seen on application to Messrs. Bramwell & Harris, engineers, 5, Great George Street, Westminster, S.W.

BUSINESS NOTICES, &c.

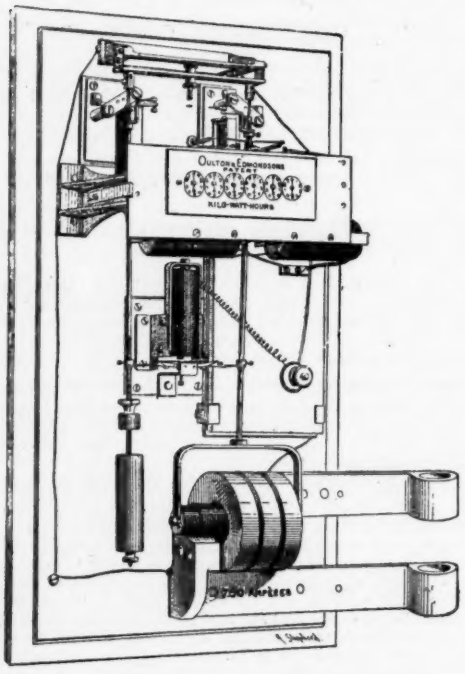
J. A. Berly's Universal Electrical Directory for 1893 (12th year), is now ready, 784 pp. This standard work contains a larger amount of trade information than any other similar publication, and should be in the hands of every engineer or electrician. Free within the Postal Union for 4s.

Cable Communications.—The following are the interruptions which have occurred, and repairs which have been effected, to the South American Cable Company's cables during the past week:—Assab-Massouah cable, interrupted May 15th, 1893; Gibraltar-Tangiers cable, repaired May 16th, 1893.

Telegraph Rates to the Cape.—The South African Trade Section of the London Chamber of Commerce had under its consideration at its annual meeting on Tuesday last the question of telegraph rates to the Cape, and the ways and means to be adopted for obtaining a reduction. This question seems to have been discussed a few months ago at a Congress of Chambers of Commerce at Johannesburg, when it was affirmed: "That in the opinion of this Congress the present rates for telegraphic messages charged by the Eastern Telegraph Company are so high as to limit the use of the cable, and that a considerable decrease thereof would result in a great development of the traffic; and that the Governments of the various states and colonies of South Africa be urged to enter into negotiations with the cable company with a view to concluding a convention on the basis of the right of fixing the charges, being transferred to those Governments, they guaranteeing the company a fair and equitable return." It was mentioned that there had been some talk of an American syndicate laying a cable by way of South America, but nothing further had yet transpired in connection with that proposal. Sir Chas. Mills said he did not know of any tangible opposition to the Eastern Company, unless that of the telegraph which Mr. Cecil Rhodes was constructing across the mainland, which would, of course, become a competing line. In reply to questions addressed to him, he said that there was no contract between the Cape Government and the Eastern Company which would prevent an opposition cable being laid, and so far as the Government was concerned the company were quite free to reduce their rates. The company was, of course, subsidised. There was a strong feeling on the part of the meeting that an attempt should be made to carry out the spirit of the resolution of the Congress at Johnnesburg, and it was resolved to communicate with the Cape Chambers of Commerce, urging them to make representations to the Cape and Transvaal Governments.

Electric Launches.—Messrs. Drake & Gorham are at present engaged in fitting up two launches for Thames use, one of these is the property of Messrs. Salters, the well-known boat builders, at Oxford, and the other is the electric launch *Florentia*, the property of Mr. W. T. Crawshay. This launch, which was fitted up by another company with electric power during the last season, has been entirely dismantled and refitted throughout to obtain increased speed. It will be remembered that both Mr. Drake and Mr. Gorham, as managing engineer and works manager of the Electric Power Storage Company, were practically connected with the design and manufacture of the first successful electric launches built for the Duke of Bedford, and the Sultan of Turkey, both of which were exhibited on the Thames.

The Oulton-Edmondson Meter.—In the Electrical Review for January 23rd, 1891, we gave a description of this electricity meter. The illustration below will show the alterations and improvements which have been made in it since that date. Though electricity meters of the double pendulum type have long been in use, their more extensive adoption has been somewhat prevented by the following important defects, viz.:—The synchronism of the pendulums was extremely difficult to maintain; the clockwork required winding up at short intervals; the measurement was proportional only through a very small range. In the Oulton-Edmondson meter these objections are said to have been entirely eliminated, the synchronism being perfect, the pendulums driven without clockwork, and the measurement of the current proportional throughout any range. This meter consists of two pendulums, each driven (without the intervention of clockwork) by a small impulse arm, acting on the pendulum by the force of gravity, and lifted at each double vibration by an electro-magnet. As a timekeeping arrangement this is claimed to be superior to anything heretofore known, all friction having been eliminated, except that of the very fine pivots on which the impulse arm moves as its centre. In the Oulton-Edmondson arrangement there is no locking or unlocking, and the impulse given to the pendulum being dependent on gravity alone and practically free from friction, is absolutely constant, hence its excellent timekeeping qualities. The synchronism of the two pendulums is insured, not alone by their accurate timekeeping, but advantage has been taken of the well-known principle that two



bodies having the same period of vibration will vibrate in unison if connected together by any medium which can convey the vibrations from the one to the other. The two pendulums, instead of being hung from a rigid support, are both suspended from one bar, which is itself suspended by stiff springs. The bar thus becomes the medium by which the vibrations of the pendulums are kept in unison, so long as no current is being consumed. As soon, however, as the flow of current through the main coils alters the period of the one pendulum it is "out of tune," as it were, with the other, and is free to register the current as required. The motion of the synchronising bar is so slight that it can only be seen by a very powerful magnifier, yet it perfectly accomplishes its purpose of giving stability to the synchronism of the pendulums. The impulse arm forms part of the circuit of the electro-magnet which lifts it, and the circuit is closed by a projection from the pendulum coming in contact with the arm. The points of contact are of iridio-platinum, and are protected from sparking by a condenser and a resistance coupled across them. This arrangement prevents sparking. There is a slight deposit of very fine dust near to the contacts, apparently collected by the static charge, but the surfaces actually coming in contact remain perfectly bright and clean. This feature is as interesting as it is important. The working of the two pendulums in a 100-volt meter takes only ·01 ampère. The "volt coil" of the registering pendulum vibrates within the main coil (see illustration), and is in the same high resistance circuit as an electro-magnet placed between the pendulums. The total consumption of current for maintaining the action of the meter is ·02 ampère. Though this meter is a most accurate one it is not a delicate instrument, but is well adapted to all the requirements of electric supply companies, whether for house supply, charging accumulators, or registering the output of the generators. It is made for currents of 25 to 1,000 ampères. The engraving shows one for 750 ampères, made for central station work.

Ship Lighting.—Messrs. Haddon & Co., of 127, Bothwell Street, Glasgow, have just completed a new installation of electric light on board the ss. *City of Rome*. The plant consists of two compound wound dynamos of the "Castle" type, having an output equal to 500 16-C.P. incandescent lamps. The main switchboard is of their own design and manufacture, and is a simple yet efficient arrangement whereby, without any possibility of confusion, any division of the lights can be run by either of the machines. The installation is giving every satisfaction and is evidently a marked advance upon the previous lighting. We understand the same firm have secured the fitting up of two new vessels.

Williamson Electrical Engineering Co., Limited.—At an extraordinary general meeting of this company, held at 14, St. Anne's Square, Manchester, on May 2nd, it was resolved that the company be wound up voluntarily, as by reason of its liabilities it could not continue its business. Mr. Sharples, of Manchester, was appointed liquidator. The *London Gazette* contains an announcement to the effect that creditors of the above company are required by October 2nd, 1893, to send their names and addresses and particulars of their claim to Mr. Sharples at the address stated above.

The Boy Messengers and Electric Call Company, Limited.—At meetings of this company held at 25, New Oxford Street, on April 22nd and May 9th, 1893, a resolution was passed winding up the company with a view to the sale of its undertaking, business and assets to the District Messenger Service and News Company, Mr. Montague Pawson, of Messrs. Jackson, Pixley, Husey and Company, of Coleman Street, E.C., was appointed liquidator.

Coatbridge Electric Lighting.—The Scottish House-to-House Electric Supply Company have concluded a contract with the Brush Electrical Engineering Company, Limited, for the complete equipment of a central electricity supply station at Coatbridge. The installation will be on the Mordey-Victoria alternate current system, with the generators driven by "Griffin" gas engines and Dowson gas.

Drake & Gorham.—The new railway offices at King's Cross are to be lit throughout by means of 636 incandescent lamps, Mr. A. H. Preece being consulting engineer for the work. The result of the tenders received show very close estimating, all of them, we believe, being within £50. The contract has been given to Messrs. Drake & Gorham, 66, Victoria Street, S.W.

The West India and Panama Telegraph Company.—Mr. Andrew Gray, of Helensburgh, who has acted as assistant to Prof. Jamieson in his electrical engineering laboratory, has been selected by the directors of this company as assistant electrician on a three years' engagement. Mr. Gray will proceed to the West Indies and join the ss. *Grappler* next month.

Woodhouse and Rawson Electric Manufacturing Company, Limited.—A general meeting of the shareholders in this company is to be held at the office of the company, Room 433, 11, Queen Victoria Street, E.C., on June 16th, at three o'clock, when the liquidators will lay an account of the winding up before the shareholders.

Wood v. Woodhouse & Rawson United, Limited.—In the Chancery Division of the High Court of Justice, on Saturday the 13th inst., Mr. Justice North, on a motion for judgment in this action, made the usual order in a debenture holder's action at the suit of the plaintiff suing on behalf of himself and other debenture holders.

Nottingham Electric Lighting Company, Limited.—A general meeting of the shareholders in this company is to be held at 22, Low Pavement, Nottingham, on June 12th, at four o'clock p.m., to receive the liquidator's report regarding the winding up of the company.

Lists.—We have received from Messrs. Johnson & Phillips a copy of their latest list of dynamos and motors, in which are given special quotations for these machines.

Mr. A. P. Lundberg has also sent us a list of his "Unique" switches.

Change of Address.—Messrs. Crosier, Mills & Co. are removing their offices from 9, Queen Street, to 58, Collingwood Street, near the Central Railway Station, Newcastle-on-Tyne, where they will have a showroom for the display of carbons, machine tools, &c.

Great Northern Railway Electric Lighting.—The Great Northern Railway Company have accepted the tender of the Brush Electrical Engineering Company for arc lamps and accessories in connection with their central station at Holloway.

Hotel Electric Lighting.—The Electric Wiring and Fittings Company, Limited, of Nottingham, are fitting up the "Black Boy" Hotel, Nottingham, with 140 lights in readiness for the Corporation supply.

Moffat Electric Lighting.—The Police Commission have invited Messrs. Woodhouse and Rawson to report upon the best method and the probable cost of electric lighting Moffat.

Fire.—A serious fire occurred on Monday afternoon on the premises of Messrs. Lea & Son, electrical engineers, of Chester Street, Shrewsbury.

CITY NOTES.

The London Electric Supply Corporation, Limited.

THE directors' report and statement of accounts for the year ending December 31st, 1892, reads as follows:—

"The board of directors have the honour to submit to the shareholders their annual report for the past year. The reports of Dr. Fleming and the engineer are appended hereto. They describe the new works that have been carried out during the year, and the general condition of the company's stations and plant. The measures taken to reduce the cost of producing the current and increase the efficiency of the generating plant have proved satisfactory. Owing to the autumn being the only period of the year when extensive alterations or additions to the generating machinery can be prudently carried out, the advantages gained were but slightly felt during the past year, but, as stated in the engineer's report, the current year will realise the full benefit of the work done. Further measures are being taken, as described in the engineer's report, whereby the proportion of current sold to current generated will be largely increased. As a consequence of competition which has arisen among the several companies, the standard charge per unit has been reduced from 7½d. to 6d. The electric current at its present cost being now about equal to that of gas, the board feel justified in anticipating a rapid extension of electric lighting. The increase in the number of lights supplied during the past year, particulars of which are given in the engineer's report, amounted to about 40 per cent. This rate of increase has been more than maintained during the first four months of the current year, and in face of severe competition. The board regret that the year's working has resulted in a deficit of £3,914 9s. 7d., which is partly due to the slow rate of increase of the business in the early part of the year, and partly to the diminution in the number of units sold per lamp installed. It may, however, be observed that a comparison of the accounts shows that whereas in the December quarter of 1891 there was a loss of £821 5s, there has been a profit of £1,486 15s. 10d. in the corresponding quarter of 1892, and that in the quarter ended March, 1892, there was a loss of £833 13s. 1d., there has been a gain of £1,113 8s. 8d. in the corresponding quarter of the current year. Major C. B. Waller, formerly manager and secretary, has been elected a director in the place of Mr. Arthur F. Wade resigned. Mr. Henry F. Lewis, for many years general manager of the Western Counties and South Wales Telephone Company, has been appointed general manager; and Mr. R. Stewart Bain, the accountant, has—while retaining that post—been appointed secretary. The directors retiring, in accordance with the articles of association, are the Earl of Crawford, Sir Coutts Lindsay, and Lord Wantage, all of whom, being eligible, offer themselves for re-election. The auditors, Messrs. Kemp, Ford and Co., who retire in accordance with the articles of association, offer themselves for re-election."

THE ENGINEER'S REPORT.

To the Directors of the London Electric Supply Corporation, Limited.

Gentlemen,—I have the pleasure to report that during the past year the working has been satisfactory, and that many improvements in mechanical and electrical details have been made with the best result; so that, of late, the interruptions in the supply of current have been few and unimportant. At the commencement of the year we had 35,100 lights connected. At the end of the year the number had increased to 46,197. Up to the present date the number amounts to 56,200 lights, and we have orders for a considerable number of lamps in course of execution. Important additions have been made to our generating and other plant. A new dynamo of 300 H.P., driven by a set of triple expansion condensing engines, has been erected, from which we have obtained excellent economical results. The machine is able to deal with the early morning load during a considerable part of the year. A machine of similar size is now being built for us, which, when brought into use, will enable us to work our daylight load with greater economy than has hitherto been possible. These machines will constitute a useful auxiliary power, as they can be worked in parallel with the larger machines with considerable economy. The re-modelling of the two 625 H.P. dynamos has been effected, and the output of the machines increased from 8,500 lights to 12,500 lights each; an advantage which has been secured by a relatively small outlay. The high tension transformers, which gave us so much trouble in previous years, have done their work well. This I attribute to the careful and intelligent manner in which these instruments have been overhauled in our repairing departments at Deptford. The trunk mains have worked satisfactorily during the year. They were very seriously threatened, and suffered considerable damage, by two fires which occurred on premises contiguous to the mains. To safeguard us in future from such consequences I am now laying underground mains in substitution for those affixed to the South Eastern Railway parapet. When this work is completed the whole of our trunk mains will be underground, with the exception of the short section which crosses the river by Charing Cross Railway Bridge. During the year we have laid down eight miles of distributing mains, making a total of about 35 miles of this description of main, all of which is in a satisfactory condition. The whole of the distributing stations now in use are fully equipped with the permanent switching gear, and these stations are working well. The system for condensing the exhaust steam has been completed during the year, and has been in work for some months past with the economical and mechanical advantages which I anticipated. The generating and distributing plant has been kept during the year in good order, and is working to my entire satisfaction.

P. WALTER D'ALTON,
Engineer-in-Chief.

Stowage Wharf, Deptford,
May 4th, 1893.

To the Directors of the London Electric Supply Corporation, Limited.

Gentlemen,—I have read the report of your engineer, and substantially agree with the same. In addition to the remarks made by him, I may add that at the beginning of the year 1892 I began to carry out a careful series of experiments on the energy losses in the house transformers. The result of this investigation was to show that an immense improvement could be effected in the corporation's system by replacing the existing house transformers by others of a more modern type. This work you have now sanctioned, and it is being carried out, and the result will be to effect a great economy in fuel. In the course of these experiments we discovered a very simple method of regulating electric pressure, which we have applied to the trunk mains with satisfactory results, in that we are now able to connect and disconnect mains without producing changes of electric pressure injurious to them. The high tension transformers have during the last year given very little trouble. The methods of connecting and disconnecting them to the circuits have been so far perfected that failures of these transformers are now very rare. When the replacement of the whole of the house transformers is effected, and when the other improvements described by your engineer are all fully at work, I think there is every reason to believe that the system of supply will, so far as economy and efficiency of working is concerned, compare very favourably with other systems.

J. A. FLEMING, M.A., D.Sc., F.R.S.

University College, London,
May 4th, 1893.

ABSTRACT OF ACCOUNTS to December 31st, 1892.

CAPITAL ACCOUNT.

Dr.	£	s.	d.
To Expenditure per last account	793,434	17	0
„ Further expenditure to December 31st, 1892 ...	27,304	19	7
„ Balance	15,650	3	5
	£836,390	0	0

Cr.	£	s.	d.
By Ordinary shares	555,000	0	0
„ Preference shares	243,730	0	0
„ Debentures	37,500	0	0
„ Forfeited shares	160	0	0
	£836,390	0	0

REVENUE ACCOUNT.

Dr.	£	s.	d.
To Generation of electricity	14,699	1	8
„ Distribution of electricity	4,221	5	3
„ Proportion of rents, rates, and taxes	2,943	8	8
„ „ „ management expenses	5,465	6	10
„ „ „ law and parliamentary charges ...	387	10	8
„ Stores at December 31st, 1891	479	15	8
	£28,196	8	9

Cr.	£	s.	d.
By Sale of current per meter	21,639	2	2
„ „ „ under contract	359	1	3
„ Rental of meters, converters, &c.	1,452	15	10
„ Transfer fees	12	2	6
„ Other items	230	9	11
„ Stores on hand, December 31st, 1892	588	7	6
„ Balance	3,914	9	7
	£28,196	8	9

NET REVENUE ACCOUNT.

Dr.	£	s.	d.
To Balance from last account	6,151	19	1
„ Depreciation, interest on debentures, law charges, &c.	1,396	17	10
„ Revenue account, balance	3,914	9	7
	£11,463	6	6

Cr.	£	s.	d.
By Balance from account	11,463	6	6
	£11,463	6	6

General Balance-Sheet.

Dr.	£	s.	d.
To Capital account	836,390	0	0
„ Sundry tradesmen and others, on construction of plant, machinery, fuel, &c.	6,228	10	11
„ Sundry creditors on open accounts	8,193	6	10
	£850,811	17	9

Cr.	£	s.	d.
By Capital account	820,739	16	7
„ Cash at bankers } ... ... „ in hand }	1,462	7	10
„ Sundry debtors for current	7,953	11	11
„ Other „	8,604	7	5
„ Stores on hand	588	7	6
„ Net revenue account	11,463	6	6
	£850,811	17	9

Mr. Staats Forbes presided over the ordinary general meeting of this company, which was held at the offices of the company, Adelphi Terrace, on Wednesday last.

In his speech the Chairman said they were emerging from a position of great difficulty. They had insisted during the last two or three years upon the engineer and the scientific men, upon whom the success of that and other companies depended, pledging themselves from year to year as to the progress of the undertaking, not so much as a commercial, but as an experimental scientific undertaking, which would some day or other be capable of returning some adequate interest upon the capital expended in it. The misfortunes of the company entirely rested upon the want of knowledge of electrical possibilities. They knew the disasters which paralysed the whole of their business, and which naturally prejudiced the public against them. The works of the company were started on highly scientific and highly economical principle, but the principle had more or less broken down in practice; if it had broken down completely they might have made up their minds to make the worst of it, but the scheme contained within itself the possibility of being made equal to the original expectations. After the terrible catastrophe of November, 1890, they had 38,372 lamps connected; that number immediately dropped to 900, and soon ceased altogether. They had to begin business again, but in May, 1891, they had got back 23,000. In 1892 they had some further troubles, which caused them to stop two or three days. It caused a shock to the public confidence, but, in spite of that, they had gradually crept up to 56,690 lamps. The reason of that had been that the various difficult operations involved in getting to the lamps had been overcome with some degree of certainty, and the thing now really looked like an efficient machine. If progress was made in the next two years equal to that of the last two, they would be out of trouble. One of the things to be borne in mind in this matter was that the working expenses were made up of two kinds of items. An item which was, as it were, permanent, and had little to do with the production of current, and which diminished in proportion as the number of lamps increased. The other item was that immediately connected with the production, namely, coal. There was a direct relation between the number of units sold and the coal bill, but the fixed charges, such as maintenance and supervision, remained the same no matter what the number of units happened to be. The question before them that day was whether they were to throw up the sponge or not; he did not think the board would advise them to do this. For although there was not much in that report upon which they could congratulate each other, still it presented elements of future hope, and, so far as appearances went, they rationally believed that the multiplication of customers would go on, and with the multiplication of customers receipts would increase, whereas a large portion of the expenses would remain stationary. The receipts in 1891 were £28,600, and it was unfortunate that after two years they should only be £24,281. The expenses in these two years had been practically the same. He would advise shareholders to read carefully the report of the engineers, which showed that during the year they had got through a good deal of work. After further reference to the original scheme of the company, he said that the practical conclusion of a good many people was that it would have been wiser to have had smaller units. During the year they had spent a little money on a new unit 300 H.P.; they had got one at work, and another in course of construction, and it looked at present as if they would be obliged to leave for a long time to come the working with implements of such enormous cost, and so exceptional as 5,000 H.P. As they, the shareholders, knew, the plant consisted of two 625-H.P., and two 1,250-H.P. machines, which were all at work. The 1,250-H.P. machines were not altogether without drawbacks even now. They were suffering now, and would continue to do so, from the errors of judgment upon which the concern was started. They now supplied current to the public by meter, they had formerly supplied by contract, but by adopting meters the character of their business had entirely changed. They were authorised to charge 7½d. per unit, and the success of their undertaking depended on the price at which they were able to produce a unit. If they were able to double the number of lamps during the next two years the cost per unit would be so reduced that they would be lifted out of the slough of despond into comparative prosperity. The dynamos which were already working would enable them to light 90,000 lamps, and if they reckoned the low estimate of 10s. per lamp per year there would be at once an income of £45,000, against this the £28,000 expenditure incurred last year would go a long way. In 1891 every unit produced cost 10·14d., of which 4·61d. was generation cost, coal was 2·36 per unit. By sundry improvements, such as condensing, which reduced the consumption of coal, they had reduced the price per unit in March of this year to 5·71d., in March of last year it had cost 8·06d. to produce a unit. The cost of coal per unit now stood practically at 1·31d., and the enormous proportions of 4·30d. would be stationary, and would be diminished exactly in proportion as the units sold increased. He thought that the other supply companies had been guilty of a great act of folly in reducing the rate. At any rate, they had to look the matter in the face and take the standard of charge of 6d. per unit. Coming to the report of the engineers, he would remind the shareholders that of the current generated at Deptford, only 42 per cent. was actually sold; fortunately they knew when this loss was caused, and with new transformers which they were going to erect, the efficiency would be about 70 per cent. They were watching the development of the company from month to month, and in the March quarter of this year, instead of a loss, there had been a gain of £1,113, and this was practically £2,000 to the good.

After some remarks from shareholders, the report was adopted, and the retiring directors and auditors re-elected.

Yorkshire House-to-House Electricity Company, Limited.

The ordinary general meeting of the members of this company was held at the registered offices of the company, Central Electric Lighting Station, Whitehall Road, Leeds, on Friday last, under the presidency of the chairman of the company (Mr. Grosvenor Talbot).

The Secretary (Mr. W. T. Green) submitted the report of the directors and the statement of accounts, which have already appeared in the Review.

The Chairman, in moving the adoption of the report and balance-sheet, said there was hardly anything to say with regard to the statement which the secretary had read. It was simply a record of the work done and the money spent up to September 31st last year. As the shareholders well knew, since that date the company had made considerable advances upon their works, and there would be very much more to report in a year hence, when the accounts were made up. This meeting was not one at which he could go into any detail regarding the works and their progress. The directors thought they had done well. They opened their works on Wednesday, and a great number of persons in various towns in England and Wales inspected them prior to the ceremony. They were of opinion that their works were of the very latest type known, and they would, he could assure them, be most efficiently controlled by the directors of the board. There was no reason why the company should not succeed. Coal was cheap, water was cheap, and the situation of the works was good. The directors were well aware that the works would come in for a fair share of keen criticism from competing electrical companies in the kingdom. He trusted they would all endeavour to make the undertaking a success. He thought the shareholders would be of opinion that so far the directors had proceeded in the right direction, and it only needed the co-operation of the officials of the company to make the company a paying concern. There were some 5,000 or 6,000 lights to be taken up yet, and the board were hoping to secure the additional capital to proceed with the original plans. It was a great pleasure to the board that they were so well and influentially supported on the occasion of the opening ceremony the other day; but it was not proposed to make any charge upon the shareholders on account of those proceedings.

Mr. Hudson seconded the motion, remarking that he did so with every confidence in the company.

The resolution was carried.

The Chairman then moved that Mr. Robert Hudson, a retiring director, be re-elected.

Mr. Edison seconded.

The Chairman next moved that Mr. Samuel Ingham be also re-elected a director of the company.

This was seconded by Mr. Pearson and agreed to.

Mr. Lupton proposed, Mr. Redmayne seconded, and it was carried, that Mr. John Gordon be re-elected auditor of the company.

Mr. Armistead said that there were several residents in Lowerhead Row anxious to have the benefit of the company's light. Could some arrangement be made to lay the mains?

The Chairman stated that the company had only raised capital enough to cover one area, and that area had been completely canvassed. They could not spend much more money on mains, as their capital was exhausted, except what remained for current work. The company hoped to cover Lowerhead Row in time, and if the gentlemen in question would send in their applications, they would be considered.

Another Shareholder in the company enquired how many lights the machinery was fitted up for at the present time.

The Chairman replied 16,000 lamps, and already between 10,000 and 11,000 of them had been applied for.

On the motion of Mr. Fowler, a hearty vote of thanks was accorded to the chairman, and the proceedings terminated.

A number of the shareholders present afterwards proceeded round the works and inspected the machinery.

Elmore's Patent Copper-Depositing Company, Limited.

THE adjourned extraordinary general meeting of this company was held on Friday at the City Terminus Hotel, Mr. Joseph Todhunter, J.P. (one of the three gentlemen who have conditionally consented to act as directors), presiding, on the motion of Mr. J. J. Atkinson, the chairman of the existing board. After reminding those present that the meeting had been adjourned to offer an opportunity to shareholders to subscribe for the 8,800 preference shares of £2 each proposed to be issued, the chairman remarked that the total promises only reached about £12,000 of the £17,600 required. Mr. Pritchard and himself felt that, unless the whole sum was forthcoming on that occasion, they would be bound to fulfil their obligations, and return by Tuesday next the deposits that had been received. Believing that it would be a disastrous thing to allow the business entirely to slip out of their hands, he had, on his own responsibility, approached certain financial people of high standing with the view of obtaining from them a guarantee in the event of the shareholders not taking up the new shares. Two days ago he had an absolute promise of a guarantee of such capital as would be necessary to reconstruct the company upon a sound basis; and although it was in abeyance for the moment, in consequence of the unfavourable state of the money market, he had no doubt he should be able to get the money underwritten if required. At the present time their subscribed capital was £182,390 in fully-paid shares of £2 each. The scheme proposed was, that a new company should be formed with the same nominal capital as in the present one—namely, £200,000, and that the £182,390 be issued in £1 shares credited with 17s. paid, and that every person holding one £2 share should receive for it two £1 shares in the new concern with a liability of 3s. on each. By that means it was estimated that about £10,000 would be raised with which to provide extra copper for the works as well as the necessary additional machinery. He did not see his way to any alternative scheme.

Mr. HANCOCK asked whether it would not be possible to conduct the business with the £12,000 already obtained, provided that those who had subscribed the money consented. He knew a good deal about the kind of business they were engaged in, and having been to the works, he wished to say that they had been laid out and designed in a skilful manner, and that the losses which had occurred had not been caused by Messrs. Elmore.

Mr. LAMONT asked if they could not raise an additional £5,000 on their land, and in that way make up the balance required.

After further discussion, in which a general wish was expressed for an extension of time to allow of the preference shares being subscribed,

The CHAIRMAN said that he declined to agree to any further adjournment, and that the matter must be settled one way or the other at that meeting. No further sum could be raised on their land as it stood. In reply to a question as to the charge to be made for the proposed underwriting in case of reconstruction, he said the commission would be 10 per cent., which he regarded as a lighter burden than for them to be perpetually saddled with £17,600 worth of preference shares.

An attempt was then made to raise the balance of the sum required, and promises were received raising the amount to £14,800 out of the total of £17,600

The CHAIRMAN announced that unless the remainder were forthcoming by Tuesday, the deposits already received would be returned.

A resolution was then passed that, in the event of the preference shares not being fully subscribed, a meeting should be called to consider the question of voluntary liquidation and reconstruction.

West India and Panama Telegraph Company, Limited.

THE thirty-second ordinary general meeting of the above company was held at Winchester House, E.C., on Tuesday last, Mr. C. W. Earle presiding.

The SECRETARY, Mr. R. T. Brown, having read the notice convening the meeting, also the minutes of the previous meeting,

The CHAIRMAN stated that it was exactly a year ago that it was his sad duty to announce the first death that had occurred on their board, since they were elected in 1874. Now again he had the same painful duty to perform in reporting that another member of the board had been taken away. To-day they mourned the loss of Sir James Anderson. After paying a lengthy tribute to that gentleman's memory in regard to his very long experience, his liberality, his kindness, and honesty, &c., he proceeded to the business of the meeting. The report and accounts were taken as read. The principal feature of the accounts presented, was that there was an increased revenue of £2,217, and a decreased expenditure of £141. But that small decrease did not quite measure the real decrease, because in the account of the corresponding period they charged a sum of £2,119 to the reserve fund, some of the repairs that they had made being then of so extensive a character as to constitute renewals of the system, and therefore they might look upon the report altogether in round numbers as showing an improvement of about £4,000 over the corresponding period of the previous year. The items which constituted the diminution in expenditure were chiefly as usual, and they were to be found in Abstract C, which related to the repairs to the system. This year the repairing bill was about £3,000 less than it was in the corresponding period of 1891. In fact, they used this year in the maintenance of their system, 37 knots as against 78 last year, and there it was that the whole difference in the expenditure lay. But as they had only put 37 knots of new stuff into the system, they therefore—in order to keep their reserve fund at what it ought to be at the end of 1892—had decided to put £1,500 into that fund. Abstracts A and B offered no subject for particular remark. They had slight variations, sometimes decreases but sometimes there were increases; but they were altogether dependent upon the staff fluctuations and similar expenses, which were not at the moment worthy of consideration. The traffic receipts showed an increase of £2,065, but it must be borne in mind that that compared with a decrease of £7,350 which they had to report in the previous corresponding half-year, and that was owing to the reduced tariffs that they were impelled to initiate in that year. The increase this year may be attributed entirely, he thought, to the improved position of West Indian trade; sugar and cocoa and the other things that the West Indian people dealt in had risen very much in value, and that had given a fillip to the telegraphic business. Therefore, in comparing the present account, with its increase of £2,065 in traffics, as against the £7,350, they got a figure of £5,285 as a loss compared with what they were making in the corresponding half-year of the year previous to the one in which they had the reduced tariff, and that he presumed was the measure of what that loss had been; they might put it down at £10,000 a-year that they had had to give to the colonies. Yet they were told that if they would only reduce their tariffs, they would have a much larger business. That had been tried in various parts of the world, and he thought he was right in saying that wherever it had been tried at first, it had effected a considerable loss, and in countries like the West Indies, where the inhabitants are not European or Anglo-Saxon, the traffic did not rebound in answer to the decreases made. It was rather disheartening, in the face of what they had done in that way, to find themselves reduced in subsidies. The colony of Trinidad, which had given them previously £6,000 a-year, had announced its Act reducing it to £3,000 a-year only. The colony of St. Lucia had reduced their subsidy from £800 to £500 a-year. That seemed rather rough terms after the company had given them considerable reductions in tariffs. There was, however, something to be said for those colonies, for when the West India directors took office in 1874, the subsidy payable by Trinidad was £2,500 a-year, and their term of subsidy was 10 years, for which it had been originally granted. The company made urgent requests to them, and asked them for something more, and they very liberally increased to £6,000, or more than double what they had originally advanced them. The colonies are not very flourishing, and now they have knocked off £3,000 of the increase they then gave them. They could not complain; the colony had given them something, and had now taken it away. The case of St. Lucia was somewhat similar. When the directors took office, they received a subsidy of £500; that was afterwards increased to £800 a-year, and now it had been reduced to £500 a-year. It was very disappointing, but they had no power of influencing the colonies in their favour. One of their ships had been brought home for the purpose of fitting her with a new boiler. This had been very successfully done, and the costs would appear in the next half-yearly account. He concluded his remarks by moving that the directors' report and accounts to December 31st, 1892, be received and adopted, and that the dividends as recommended in the report be declared.

Mr. HENRY WEAVER seconded the motion.

Mr. STANSFIELD asked whether the directors could fix an idea as to the maximum of the reserve fund. Mr. Kenyon advocated the abolishment of one of the ships, as he considered that one ship would be able to do the necessary work. Mr. Griffiths and a number of other shareholders thought more might be done in the way of cutting down expenses. A question was asked: "Are there any other West Indian Governments likely to reduce their subsidies?" Another question was: "Have the board any particulars regarding the position and prospects of the opposition company?"

The CHAIRMAN, in reply, stated that they had no intimation of reductions in other subsidies, but they were, of course, liable to such. Regarding the opposition company, they only knew that their line had broken down at both ends, and all its traffic was coming over the West India and Panama line. In respect to the maximum of the reserve fund, he could not say much on that matter; they must continue their contributions to that, so that they might be well prepared for renewals when they became necessary. He explained that it was absolutely impossible for them to do with less than two ships. With regard to cutting down expenses, he would like the shareholders to say how that was to be done. They had worked hard at that point. They had a ship ordered home, and would lay her up here or dispose of her; in any case, he did not think they would send her out again immediately, and that would mean a saving of several thousands a year.

The motion was then put to the meeting, and carried unanimously.

The retiring director, Mr. W. S. Andrews, was re-elected, and the auditors were likewise re elected, a SHAREHOLDER suggesting that they ought to have two auditors for a large company like theirs.

The special meeting was then held to alter the articles, making the minimum number of directors four instead of six. This was agreed to, Mr. GRIFFITHS and two other SHAREHOLDERS dissenting, as they considered a large board essential to the proper management of the business.

The meeting closed with the usual vote of thanks to the chairman and directors.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending May 14th, 1893, amounted to £787; week ending May 15th, 1892, £709; increase £78; total receipts for half-year, 1893, £16,940; corresponding period, 1892, £15,607; increase £1,333.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending May 12th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,741.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation May 11th.	Closing Quotation, May 18th.	Business done during week ended May 18th, 1893. Highest.	Lowest.
195,100*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	101 —104	101 — 104	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	51½ — 52½	50½ — 51½	51½	...
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	93 — 94	91½ — 92½	93⅜	92
2,876,140*l*	Do. do. Deferred	Stock	12½ — 13	11½ — 12	12⅜	11⅞
130,000	Brazilian Submarine Telegraph, Limited	10	11⅞ — 12¼	11⅞ — 12¼	12	11⅞
36,400*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	107 —111	107 —111	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3¼ — 3⅜	3 — 3¼	3 7/16	3 5/16
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2¼ — 2⅜	2⅛ — 2⅜	2⅜	2⅛
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	108 —110	108 —110	109½	...
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
630,000*l*	City and South London Railway	Stock	37 — 39	37 — 39	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	12¼ - 12⅜	12 — 12⅛	12⅛	...
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	10¼ — 11	12 — 13	12⅝	10⅜
$7,716,000	Commercial Cable, Capital Stock	$100	140 —150	140 — 150	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	3/16 - 5/16	3/16 — 5/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5⅛ - 5⅜	5⅛ — 5⅜	5⅛	...
16,000	Cuba Telegraph, Limited	10	11½ - 12⅛	11⅛ — 12⅛	...	...
6,000	Do. do. 10 p. c. Preference	10	18½ - 19½	18⅛ — 19½	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ - 3⅛	2⅜ — 3⅛	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅜ 12	11⅜ - 12	12	11 1/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	15½ - 15⅝	15⅝ — 15⅝	15⅝	15 1/16
70,000	Do. 6 p. c. Preference	10	16½ - 17	16½ - 17	...	...
1 5,900*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	108 - 111	108 - 111	...	...
1,294,100*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	113 —116	113 —116	114	113
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅜ - 16	15⅜ — 16	16⅛	15⅜
70,600*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	104 - 107	1 3 —106	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	104 - 107	103 —106	104¾	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	114 —117	114 —117	...	...
108,700*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	103 —106	103 —106	...	...
146,800*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	103 —106	103 —106	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	...	...
49,900	Electric Construction, Limited, Nos. 101 to 45,100	10	2½ - 3	2½ - 2⅝	2⅝	2 1/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	.. ..	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1/16 — 3/16	1/16 — 1/16	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	1/8 - 1/8	1/4 — 1/2	1/16	1/2
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	0 — 1/4	0 — 1/4	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1 — 2	1 — 2	..	...
180,227	Globe Telegraph and Trust, Limited	10	9⅞ — 10⅛	9⅝ — 9⅞	9⅞	9⅝
180,042	Do. do. 6 p. c. Preference	10	15⅞ — 16	15⅝ — 15⅞	16⅛	15⅝
150,000	Great Northern Tel. Company of Copenhagen	10	19 — 19½	19 — 19¼	19¼	...
200,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	107	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½ — 5½	4½ — 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6½ - 7½	6½ — 7½	..	
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	23 - 24	23 — 24	23⅝	23 5/16
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	43 — 46	41 — 43	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½ — 3⅛	2⅜ — 3⅛	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4¼ — 4½	4¼ — 4⅜	4⅜	4 1/16
10,000	Do. do. fully paid	5	6 — 6¼	6⅛ — 6⅜	6⅛	5⅞
38,348	London Platino-Brazilian Telegraph, Limited	10	4 — 6	4 — 6 xd	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	..
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6¼ - 6⅜xd	6 — 6¼	...	...
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 —105	102 —105	...	...
454,747	National Telephone, Limited, Nos. 1. to 438,984	5	5⅛ — 5⅜	4⅞ — 5⅛	5⅛	4⅞
15,000	Do. 6 p. c. Cum., 1st Preference	10	15 — 15⅛	15 — 15⅛	...	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	14¼ — 15	14¼ — 14⅜	14⅜	...
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5⅛ — 5⅜	5⅛ — 5⅛	5 1/16	5⅜
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	113 —116	113 —116	114¼	113½
48,800*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,451	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5 — 6	5 — 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	⅛ — ¼	⅛ — ¼	...	.
11,802	Reuter's Limited	8	7 — 8	7 — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7⅜ — 8½	7½ — 8	7⅜	...
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8⅛	8⅜	8 1/16
3,381	Submarine Cables Trust	Cert.	121 —126	119 —124	121	...
78,949	Swan United Electric Light, Limited ... ... (£3¼ only paid)	5	3 — 3½	3 — 3½	...	...
37,350	Telegraph Construction and Maintenance, Limited	12	30 — 32	30 — 32	32½	31
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	102 —105	102 —105	...	...
58,000	United River Plate Telephone, Limited	5	2 — 3	2 — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 —100	90 — 100	...	.
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	5½ — 6½	5½ — 6½	...	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	...	...
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2 — 3	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	102 —106	102 —106	104¾	...
64,242	Western and Brazilian Telegraph, Limited	15	7⅞ — 8½	7⅞ — 8 xd	...	...
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	6 — 6½	5⅞ — 6¼xd	...	...
33,129	Do. do. do. 5 p. c. Deferred	7½	1⅞ - 2⅛	1⅞ - 2⅛	2	...
178,200*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	107 - 110	107 - 110	...	...
222,700*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	106 —109	106 —109	...	..
88,321	West India and Panama Telegraph, Limited	10	1⅜ - 1⅝	1⅛ — 1⅛	1⅜	1⅛
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11⅛ - 12	11⅛ — 12	11⅛	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9½ - 10½	9½ — 10½	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	108 —111	108 —111	...	...
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
169,000*l*	Do. do. 6 p. c. Sterling Bonds	100	101 —104	101 —104	...	...
99,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,958 ...	5	5⅛ — 6	5⅛ - 5⅜	...	...

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅛—5⅜.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100—103.—Electric and General Investment, shares of £5 (£1 paid), 1⅞—2⅛.—Founders' shares, 200—225.—Electric Construction Corporation, 6 per cent. Debentures, 95—98.—Electricity Supply Corporation, Ordinary of £5, 5—5⅛.—House to House Company (£5 paid) 1⅜—2⅛.—Do. 7 per cent. Preference of £5, 5—5⅛.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅞—6⅛, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6—6⅛.—Liverpool Electric Supply Shares of £5 (fully paid), 6⅛—6⅜.—Manchester, Edison and Swan Company, 19 (£1 paid), ⅛—⅜.—Queen Anne's Mansions Lighting and Heating, 6 per cent. £100 Debentures, 101—103. Bank rate of discount, 3½ per cent. (May 11th, 1893), changed May 18th to 4 per cent.

THE COLUMBIA LAMP COMPANY'S SUIT.

THIS case was heard before Judge Hallett, at St. Louis, on April 11th, and it has resulted in a brilliant victory for the defendant company. The case was conducted very much on the lines of the late one at Boston, viz., anticipation by the claimant Goebel, but the testimony was more comprehensive and the arguments were much more fully elaborated and forcible. Amongst the fresh exhibits were lamps recently made by Goebel by the same methods he claims to have originated many years ago; and these lamps are certified to have been run for a number of hours at ordinary incandescence, and thus proved to be practically operative.

Mr. DYER opened for the plaintiffs. He dwelt on the improbable genuine character of the exhibits by reason of the difficulties involved in the evolution of the incandescent lamp. Edison, with every facility for working, had only attained success after long and carefully conducted experiments. He laid stress on the fact that none of the old lamps were practically operative, whilst the reproductions were made with all the advantages of present knowledge of the subject—filaments properly carbonised, new glass, convenient apparatus, and the like. He further maintained that even with these advantages the Goebel lamps were not commercially successful.

Mr. WITTER followed for the defence. He contended that Edison having followed a roundabout and difficult path, was no reason for saying that that route was the only one by which success could be arrived at. Besides, the question before the Court was not how Goebel arrived at his results, but did he make a lamp the same in all essentials as the Edison lamp, and was it operative? He proceeded to review previous litigation, and maintained that, as regards the Boston case, there was insufficient time to properly prepare it. Finally, a number of affidavits were read to substantiate the validity of the lamp exhibit No. 4, the genuineness of which Judge Colt had considered so doubtful.

Another lamp exhibit, No. 9, having a similar construction to No. 4, was next introduced. The history of the new exhibit (which was found in J. C. Goebel's house), as testified to by a number of affidavits, is as follows:—John Goebel made preparations in 1878 to visit Germany, and obtained a passport (shown in evidence) for the purpose. He wished to take with him, as a means of his identification, an old family parchment (also shown in evidence), but was refused by his mother, as his father valued it too highly to part with it. She gave him instead three of his father's lamps to show his relations in Germany. The expedition, however, eventually fell through and J. C. Goebel went back to the German hospital in New York, where he had previously been working. In 1879 he went to New Haven. He kept the three lamps together for a long time, and No. 9 has never been out of his possession. In 1886-7 he gave two of them to G. K. Clark. No. 9 was kept in a trunk until the end of 1891 when, the trunk being required, the contents were stowed away in other parts of J. Goebel's house, and the lamp was recently found in a drawer of a bureau. The lamp is in the same condition to-day as when he first received it. All three lamps were substantially alike. At different times he showed the lamps to a good many people, and he specified the names of some of these, and recalled certain incidents connected with the occasions when they were exhibited. A number of affidavits were produced by the witnesses who had seen the lamps and who most consistently corroborated the incidents testified to by J. Goebel. Amongst these was one G. K. Clark, who says that six or seven years ago J. Goebel gave him two lamps like No. 9. One of these Clark set up and ran at the Bigelow Company's works in New Haven in connection with a number of arc lamps. It was so arranged that when one of the carbons drew a long arc this incandescent lamp would be lighted up. It was run in this way for six weeks or two months, and gave a first-rate light. The lamp was finally broken and the duplicate which Goebel gave him is lost. Further affidavits confirmatory of Clark's testimony were also put in. This seems to be the only instance in which a Goebel lamp, claimed to be of make anterior to 1879, has been run in recent years. It is a pity that so valuable a relic should have been used up in such a manner when thousands of other lamps, to be had almost for the asking, would have better served the purpose required.

Yet another lamp, No. 11, has been found. It was given to Dr. Mayer in 1885 by Henry Goebel, and the history given was confirmed by more than one witness. This lamp is similar to No. 4 in all respects excepting that the seal at the wires is re-entrant *à la* Edison (see fig.).

GOEBEL EXHIBIT, No. 9.

Mr. WITTER proceeded to state that there were a good many more of Goebel's lamps in existence, and that some of them had found their way into the hands of persons interested in the General Electric Company, and who considered that if they disclosed what they knew their business would be injured. J. W. Flucker was mentioned as an instance of this kind. Mr. J. E. Bull, who had collected much evidence for the purpose of this case, stated that he had interviewed Flucker and ascertained from him that he had assisted Goebel to make lamps prior to 1879. The lamps they made were operative lamps and Goebel had told him that he had made similar ones for years previously. Flucker further said that he had three old lamps made by Goebel and himself prior to October, 1879, which have been in his possession ever since, and that he had memoranda to prove his statements. Two of the lamps have platinum wires, the third having copper or iron leading-in wires: two of the lamps are intact, the third being broken. But Flucker would neither produce the lamps nor swear to any of the information he had given, as he is dependent on the good will of the General Electric Company, and is, in other respects, interested in that company. If directed by the Court by subpœna, or otherwise, to disclose what he knew he would do so for either party, and efforts to compel him to disclose had been made by the defendants before Judge Thayer, but the appeal was dismissed. Flucker also mentioned that he had been approached by persons representing the plaintiff company with respect to the Goebel matter.

Another owner of old Goebel lamps is stated to be Mr. Geo. C. Crosby, whose name will be remembered from the last trial. Mr. J. H. Rhotehamel, president of the Columbia Company, in his affidavit said that he first met Crosby at an hotel in February last. The latter told him about his connection with the American Electric Company, of his visit to Goebel's house, and of the lamps and filaments he saw there. That he, Crosby, had asked Goebel to give him a number of these lamps, which request was granted, and that he still possessed them. Further, that he had mounted the lamps on a cardboard which showed the date when he had received them. Some of the lamps he had run, and with success. Crosby had remarked that he now considered these lamps very valuable, and that he would not make an affidavit in respect to them, unless he were paid what he considered they were worth—which it is understood is $100,000. He said that his testimony was important from the fact that he was the only person connected with the American Company who had any dealing with Goebel, and that the statements made by the McMahons in the last case were false.

Great emphasis was laid by Mr. Witter on this affidavit of Mr. Rhotehamel, and he contended that had testimony of this kind been forthcoming at the last trial, Judge Colt would have decided otherwise.

Two affidavits were next read by E. P. Gleason and Emil Seidel, two gentlemen who had had a conversation at the time when Edison first publicly announced his lamp. Seidel had remarked to Gleason that the Edison lamp was not new, as he knew an old man who had made lamps like them years before Edison had ever thought of doing so. Seidel had known Goebel since 1858-9, and saw him frequently when courting the latter's daughter, Sophie. He well remembers the "meat saw" lamp, the battery, conversations with Goebel on the subject, &c. He testified to Goebel's honesty, and would believe anything he said.

Mr. WITTER proceeded to say that the plaintiffs had claimed that the witnesses for the defence were not those who could be relied upon in matters of detail involved in identifying Goebel's early lamps. To controvert this, several affidavits by competent persons were read, amongst them being that of Wm. Hinton, formerly of the American Electric Company. The affidavit of the venerable Peter H. Vander Weyde, who had known Goebel prior to 1860, was also read; but it appears that this gentleman has subsequently made an affidavit for the plaintiffs, in which he denies many statements contained in the first testimony, and stating that he signed it without reading it, and assuming it to be correct. In rebuttal of this statement, Mr. A. Kenyon declares that the affidavit had been read very carefully to Mr. Van der Weyde previous to signing.

A large number of affidavits produced testified to Goebel's honesty and excellent character, and hardly one of these was contested by the plaintiffs. Altogether 150 or more affidavits were put in, and Mr. Witter argued that the manner in which they corroborated one another, was powerful testimony to the truth of the story, especially as they were met on the other side only by mere statements of opinion that the story was improbable.

Mr. KENYON then summed up. Judge Wallace when examining into the state of the art prior to Edison's invention, came to the conclusion that what is recognised as filamentary carbon for the incandescent electric lamp purposes was not then known. This opinion was arrived at on the evidence as presented at the time. If it should turn out that that was not the true state of the art as it is now maintained is the case, and "that prior to October 12th, 1879, there existed a lamp different from anything proved or studied by Judge Wallace—materially different—then his decision would have been different." If this is so, then the case must be heard on its individual merits. Mr. Kenyon maintained that all that Edison could lay claim to was the light-giving coiled filament, which is specifically mentioned in the patent, in combination with the all-glass receiver, platinum wires and vacuum. Everything else besides the coiled filament was old, and now there was overwhelming evidence to show that filamentary carbon is also old, and had been previously used in the art as an illuminant. The nearest approach to the Edison lamp in Judge Wallace's opinion was Edison's own French platinum burner, and he, "therefore, held for us inferentially that if such a carbon did exist in the art, it would have been no invention on the part of Edison to have substituted it for platinum wire." Therefore, the only question before the Court is, "Is there evidence by which the defendant can prove in the final hearing that there was a filamentary carbon in the art prior to October 12th, 1879."

Mr. KENYON then proceeded to read to the Court the definition of a filament as previously defined by Judge Wallace, having first requested the judge to hold in his hand Goebel lamps, Nos. 4 and 9, so that he might see how far the filaments conformed to the definition.

Counsel then reviewed evidence as to the thickness of several rod and filamentary burners; stated that the case now presented was different to any previous one; and then proceeded to deal with the various groups of affidavits that had been presented. Amongst other matters he referred to experiments that had been conducted with lamps made with iron and copper leading-in wires. One iron lamp had lasted 245 hours at ordinary incandescence, another ditto, 208½ hours; a third, 195 hours; a fourth, 193½ hours; a copper lamp 211 hours; whilst others were still running. Tests were also made with

reproductions of lamps made by Goebel, who was unassisted while constructing them. One of these ran for 166, another 87½, and a third 45⅝ hours.

Evidence with regard to the Torricellian vacuum used by Goebel was next discussed, counsel submitting that it had been proved to be sufficiently perfect by Goebel's reproductions, and that, therefore, the contention of the plaintiffs that the method was inadequate for the purpose must fall through. Counsel then dealt with Edison's specification, and held that all the early Edison lamps had been commercial failures, testimony being quoted to prove the point. Even Edison himself said: "I am not aware of an exogenous wood which would make a fairly operative lamp." It was not until December 27th, 1881, after having tested 6,000 vegetable growths, that he took out a broad patent for bamboo (a wood of endogenous growth) and this is not the patent it is claimed has been infringed. Goebel had been using this same material 20 years previously.

After dealing with various criticisms that had been made as to Goebel having made no practical use of his lamp; as to his having abandoned his experiments, which is not the case; that he did not understand the sub-division of light, and certain other minor points, Mr. Kenyon proceeded to show why the Goebel testimony was not made use of in earlier litigation. The American company finally acquired the Sawyer-Man patents, which they believed controlled the situation. The Westinghouse Company, Curtis, Prof. Thomson and others were interested in these patents. They believed that these patents would defeat the Edison patents; it was two great organisations fighting each other to see who should obtain the monopoly. Much as those interested in the Sawyer-Man patents desired to break the Edison patents, they were unwilling to break them by sacrificing their own, and they had no interest in proving Goebel's claims true, if by so doing they invalidated their own patents. Prof. Thomson admits that for seven years he was interested in sustaining the Sawyer-Man patents. Why, then, should he be interested in proving Goebel's claims true?

In conclusion, various attacks on Goebel's reputation were criticised; the statements of the McMahons, Dreyer and Hetzel being particularly referred to. "The fact is," said counsel, "either this defence of ours is all a vast fabrication, or our facts are proved, substantiating a dozen times over that we do not infringe. . . . . You will be told that the patent expires next year, and that it makes but little difference to us whether we are enjoined or not. . . . . The answer is that the plaintiffs did not attempt to defend their patent until five years after the issue of the patent. . . . . Edison was in the interval claiming in the Patent Office that his patent did not cover the ground broadly, but was trying to get a broad claim. Again, we tell you that the patent is as likely to last until 1897 as to expire next year, as the plaintiffs will admit that there is a case now before the Supreme Court which they have great hopes of winning, which, if decided in their favour will extend the life of this patent until 1897."

Mr. Seward then followed for the plaintiffs. Referring to Edison's specification, he contended that the patentee was not limited to the light-giving coiled filament, which was so shaped as to counteract the unsteadiness of the dynamo. In speaking of the previous custom of the use of rods, he says that he had reversed this practice of low resistance, and had discovered that carbon was stable in high vacua. The stability of carbon in high vacua is therefore the foundation of the second claim. He stated that the Court had already passed on the Goebel matter, and that this was not a new case. This case presents no facts which did not characterise the previous one. The bringing of more witnesses is not new proof. Our belief is that Goebel never had anything to do with incandescent lamps until after his connection with the American Electric Company in 1881, and that all he had done previously was with arc lamps and with platinum lamps. Mr. Seward then went on to state in various ways how it seems that the Goebel evidence had been manufactured from time to time as needed to fill up gaps. He then critically examined the defendant's affidavits, and referring to that of Mr. Rhotehamel, argued that it all still hung on Goebel's word—nothing had been proved. Referring at some length to the various exhibits, he said that Goebel claims to have made No. 5 lamp while he was with the American company. No. 5 is a verification that Goebel never knew until 1881 what constituted an incandescent lamp. He then referred to the extreme youth of most of the witnesses who testified to support the story at the time the events transpired, and concluded by maintaining that lamp exhibits, Nos. 1, 2, and 3, were so imperfectly constructed as to be incapable of use.

Mr. Fish, in summing up, contended that there was no precedent of one circuit court overruling another, unless the proof of error was absolutely certain—"clear enough to convict a man of a criminal offence." It had been claimed by the defendant that the plaintiff was derelict in that it had taken no steps to protect its patent prior to 1885, although the infringements previous to that date were frequent and flagrant. He denied that this was true, and stated that there had been no infringements, except two instances that were unimportant. Edison's time had been wholly taken up previous to 1885 in perfecting systems of distribution, &c. Since that time the plaintiffs had pressed their suits with the utmost vigour. The defendant started his factory knowing that he was violating the law, but hoped that the patent would expire before the law was enforced. He had taken his chances and must stand the consequences. His capital was so small that he had nothing to lose, and the only redress for the plaintiffs was an injunction. There were about 35 other manufacturers of lamps who went into the business for the same reason as the defendant. There are but two whom it has not yet been possible to proceed against in proper way. There are two now under restraining order besides the defendant. Mr. Fish stated that there are 80 licensees of the Edison patent in this country. These had paid for certain privileges, and the parent company was bound to protect them. If a restraining order were denied, the business of these 80 licensees would be destroyed and the licensor would be unable to keep faith with them. If an injunction were granted, the business of a small concern would be destroyed. If denied to this defendant, it could be denied to other defendants, and it meant the manufacture and sale of lamps not only in St. Louis, but in all parts of the country, by those who knowingly had infringed the patent, and knowing the risk had decided to take it. He did not believe that the lamps 1, 2, 3, 4, 9 and 11 had existed prior to 1892. Had they been, why had this evidence not been used before? Some of these lamps had been in the hands of Mr. Bull in time to use in the Westinghouse (Sawyer-Man) case had he thought them worth using. He then stated that one affidavit in the Beacon case was sworn to a month or more before the suit was commenced, another the day after the papers were filed. The story had been growing, and we can see evidence that where fresh testimony was needed to fill in gaps, a witness would make a second affidavit as to certain circumstances which it would seem could not have escaped his attention, had they existed in fact.

Goebel Exhibit, No. 11.

On April 21st Judge Hallett delivered the following opinion:—In the Circuit Court of the United States for the Eastern Division of the Eastern Judicial District of Missouri.—Edison Electric Light Company et al., *v.* Columbia Incandescent Lamp Company et al. (No. 3,707).

Complainants allege infringement of letters patent No. 223,898, issued to Thomas A. Edison, January 27th, 1880, for an improved electric lamp. This patent came under the consideration of the Circuit Court of the Southern District of New York, in the case of the Edison Electric Light Company, *v.* the United States Electric Lighting Company (47 F. R. 454), and was held to be for a lamp "consisting essentially of a filamentary carbon burner, hermetically sealed in glass a vacuum chamber." So understood it is the incandescent lamp in common use, and no question is presented in this record as to the character of respondents' manufacture. The defence to the bill and to the motion for preliminary injunction now under consideration is want of novelty in the Edison patent. Respondents aver that an incandescent lamp different in form but in all essential features the same as that now in general use, was made as early as 1854 by Henry Goebel, of New York city, and that it was used by him in various ways and at different times for many years thereafter. It will not be necessary to describe this lamp at length, as it has the same constituents as the Edison lamp. We are at the present more concerned with the struggle between the contending forces, on the one side to maintain and on the other to disprove, the existence and use of the lamp anterior to the date of the Edison invention. A large mass of testimony in the form of affidavits is offered by each party on the question of fact, which, to consider at length, would be a tiresome and unprofitable task.

The principal objection urged by complainant against the Goebel invention is that it has an impossible date; no man could make it in the time and manner assigned to it; the incandescent lamp is the product of several auxiliary arts not likely to fall within the compass of a single mind; as an achievement of science the lamp is a matter of progressive steps, some of which must be made by the world at large before others can be taken by anyone. This is no more than to say that no man can outrun his competitors to any great length in the field of scientific investigation—a proposition which has no support in reason or experience. There seems to be no reason for saying that Goebel could not reach in 1854 the point attained by Edison in 1879, unless, as was said by the dissenting Justices in the telephone cases: "It is regarded as incredible that so great a discovery should have been made by the plain mechanic, and not by an eminent scientist and inventor."

In so far, however, as it may be shown that the methods adopted by Goebel were not equal to the results obtained, the evidence should receive the most careful consideration. On this point it appears that Goebel has recently made several lamps of the form and with the material and tools formerly used by him. These lamps were tested by men of skill and experience in such matters, and they were found to be reasonably effective. They are not so good as the lamps in common use, but they can be operated, and they give reasonable service in time and capacity of light. So that in this way we have *prima facie* proof of Goebel's ability to make lamps in the way he claims to have made them before the time of Edison's invention.

It is said that Goebel is involved in contradictions and misstatements of facts due to the lapsing memory of old age or to untruthfulness. Be it so; he does not appear to be an adventurer or an impostor. It is not reasonable to believe that he made the story related in his affidavit and did not make the lamp he has described. Whatever may be said as to Goebel's veracity, he is supported at many points by witnesses of good repute who speak with precision and apparently with deliberation. As already suggested, it is not necessary or profitable to go over the testimony at length with a view to determine the relative value and weight of every part. It is enough to say that there is a fair preponderence of testimony in support of the Goebel claim.

There is not the measure of proof demanded by complainants' counsel, who maintain that the Court should require proof of the fact

beyond reasonable doubt. This degree of certainty is not often attained upon testimony in the form of affidavits where the issue is contested. And it is not reasonable to demand such certainty as to the defence. Complainants must show a clear right in support of a preliminary writ, and a defence which puts the case in doubt is sufficient to defeat the application. Goodyear *v.* Dunbar. 1 Fisher, 472. Glaenzer et al. *v.* Wiederer et al., 33, Fed. Rep., 583. Fraim *v.* Sharon Valley Malleable and Gray Iron Company, 27, Fed Rep., 457. Cary *v.* Domestic Spring Bed Company, 26 Fed. Rep., 38. Robinson on Patents, Sec. 1,171).

It is also contended that the decree of the Circuit Court of New York against the United States Electric Lighting Company sustaining the patent, which decree has been affirmed by the Court of Appeals of the Second Circuit, is conclusive of complainants' right to the writ for which they now ask. No doubt is entertained as to the conclusive effect of that decree here and elsewhere, as to all matters in issue in that cause. For although respondent was not a party to that litigation, the Court would not, on a preliminary motion, consider any matter which passed to judgment in that suit. But the Goebel defence was not made in that suit, and therefore the case has not the authority on this motion which has been ascribed to it. (National Hat Pouncing Machine Company *v.* Hedden et al., 29 Fed. Rep., 147. Lockwood *v.* Faber, 27 Fed. Rep., 63. The Bailey Wringing Machine Company *v.* F. F. Adams et al., 3d B. & A., 96).

Another suit by the complainants against the Beacon Vacuum Pump and Electrical Company in the Circuit Court, District of Massachusetts, is in a different attitude. In that suit the Goebel defence was made, and upon motion for preliminary injunction recently heard and allowed, it was overruled. It is contended that the ruling in that case should be recognised and followed as a precedent in respect to the present motion. And perhaps, if the issue, the testimony and the situation of the parties appeared to be the same in both cases, such result might follow; more from the persuasive effect of the opinion of another court on the same matter than from any notion of authority ascribed to such opinion. In courts of equal jurisdiction proceeding concurrently in the investigation of the same subject, the right and duty of each to exercise independent judgment cannot be denied. That they should in the end reach the same result is greatly to be desired, but one cannot become an echo to the other for that praiseworthy purpose. In this instance the consequences to flow from diverse opinions are not regarded as serious. In the Massachusetts Circuit, and here as well, the motion is interlocutory, and in each case the ruling may well enough stand upon the situation of the parties. And we have much additional testimony to that upon which the court acted in the Beacon case; so that upon all points I do not feel compelled to accept the opinion of the Court in that case.

The ruling of the court, however, in the Beacon case suggests the propriety of taking security from respondent for observing the decree in case complainants shall ultimately prevail in this suit. There are other considerations also which should have weight in that direction. It was suggested by complainant's counsel that respondent's is a concern of small capital, and that it was made so with intent to avoid responsibility in respect to the infringement now alleged against it. This was not denied, and I suppose we may take it to be true. The retort was in the form of a charge against complainant that it used its monopoly of electric lamps to control the sale of all kinds of electrical machinery and apparatus. This charge also passed without denial, and it is not difficult to conceive of circumstances in which it would be necessary to ascertain whether it is true. Referring only to the charge against respondent of sufficient capital and assets, the duty of the court is plain to provide for the contingency of a decision against it. It need not refer to the possible effect of cross-examination in the case of a multitude of witnesses. What now seems plain enough may altogether disappear, and new facts may come to the surface under that crucial test.

The injunction will therefore be refused if the respondents shall give a bond in the sum of $20,000, conditioned for the payment of such sum (if any) as may be decreed in favour of complainants on the final hearing of the case, the bond to be filed with the clerk of the court, and to be approved by the clerk or by a judge of the court, within 20 days from this day.

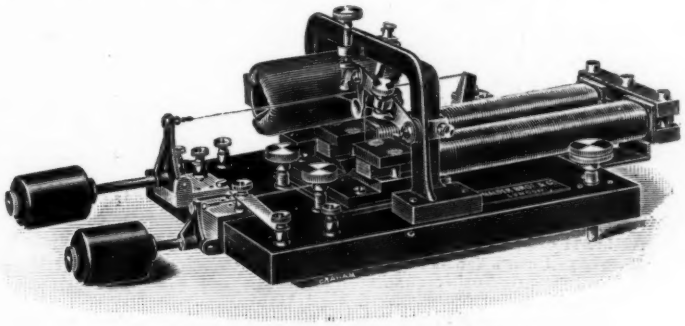


FIG. 1.—EWING'S MAGNETIC CURVE TRACER.

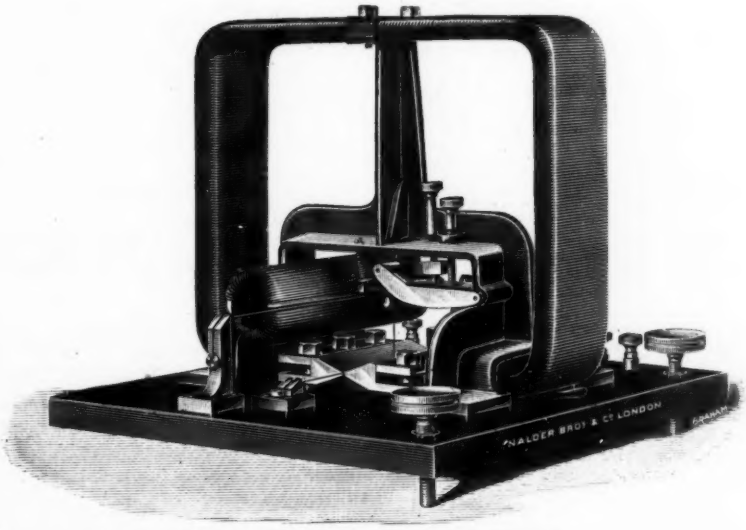


FIG. 2.—EWING'S MAGNETIC CURVE TRACER.

THE ROYAL SOCIETY CONVERSAZIONE.

THE Royal Society, on May 10th, at Burlington House, held its annual *conversazione*. It was, as usual, attended with a display of the year's extensions and discoveries. There were 38 exhibits, for the most part each demonstrated by its own inventor. It was an array of scientific instruments, together with fossil reptiles; with oysters, crabs, bacteria, fungi, and crustacea decapoda. The electrical exhibits were responsible for about one-third of the space, and quite one-half of the interest.

In the Meeting Room, on the ground floor, Lord Armstrong gave a short discourse, with lantern illustrations, upon experiments as to the nature of the electric discharge in air and water. Dust figures formed by the electric discharge were obtained by passing a spark from an electrode of lead, placed at the middle of a sheet of powdered glass. Tripoli powder serves very well for this purpose. The dust upon the glass is projected by the lantern, and the figures are seen at the instant of discharge.

Prof. C. V. Boys, F.R.S., exhibited a new method of drawing certain curves, by forming a succession of short arcs along the curve,

from a corresponding procession of arc-centres along the generating ordinates. The radius for each new step is derived from the preceding arc-increment. This is achieved with that simple magic which characterises all the methods of Prof. Boys. The scale is of transparent celluloid, specially graduated, and provided at its middle point with a stylus for describing the arcs. A flat tripod, with three needle feet, completes the apparatus.

Mr. A. A. C. Swinton exhibited some further experiments on high frequency electric discharges, for the most part on the same lines as those of Tesla and Elihu Thomson. Mr. Swinton does not agree with the notion that with increase of frequency the discharge becomes harmless. He holds that a current of given strength hurts you just as much whether the frequency is low or high; though, of course, certain startling effects are possible with a small current of high frequency, which could not be produced with anything like the same current of low frequency. We believe that Mr. Tesla now disclaims the view of harmless high frequency, and accepts the above as more accurate. It is well that the matter is so easily disposed. In addition to luminous spirals, Mr. Swinton showed some experiments to illustrate the effect of an impedence coil connected between the Leyden jars of a discharge apparatus. An incandescent lamp had one terminal connected to one end of the impedence coil, the other terminal of the lamp could be connected to the second terminal of the coil through the human body, and under these conditions the lamp would brightly glow; or, connecting one terminal of a lamp to a spark terminal, he was able to make it glow by connecting the second terminal of the lamp with his body, he himself standing on an insulating stool. The extra capacity thus added by his own body was sufficient to cause the lamp to glow.

The next thing we came upon was a miniature gallanty-show, without the figures; it was smelling very badly of heated paint, and was called a "scotographoscope." It is simply a photographer's lamp with a ground glass, upon which a lecturer may chalk in darkness if he choses.

The curve tracer for automatically deliniating the relation between the magnetisation, B, with the corresponding magnetising force, H, for different specimens, was exhibited by Prof. Ewing. A mirror is pivoted in such a way as to be free to turn about a horizontal or vertical axis. The extent of deflection of the mirror in either plane is determined by the sag of two wires, one corresponding to each plane of motion. The wires are stretched in narrow slots, forming gaps in two magnetic circuits, as shown in figs. 1 and 2. One of these magnetic circuits is made up of the iron or steel to be examined. The current through its magnetising coils also passes through one of the mirror sag wires. The second magnet is constantly magnetised by a steady current which passes through the second mirror sag wire. We have here, then, two systems, each a magnet gap, and a wire with a current through it. In the first the magnetism varies, and its variations cause a sag of a wire conveying a steady current; in the second the current varies, and its variations cause a sag, because it is in a constant magnetic field. It will be seen that these two motions truly represent the magnetisation B and the magnetising force H respectively. One system being in fact a magnetometer, and the other a galvanometer. A bright spot of light reflected from the mirror to a screen, graphically delineates the curve. We are not quite clear as to the effect the mass of the mirror has upon the accuracy of the results; it would seem to us to introduce an error, unless the readings were plotted out slowly on the screen.

Prof. A. Smithells exhibited some beautiful experiments to demonstrate the structure of flames. His apparatus is of the simplest kind, little more than an elongated Bunsen burner with double tubes of glass. By pushing up a wire he was able to separate the two parts of the flame. The structure of the flame was further shown during transition from the luminous to the non-luminous stage by using benzene vapour.

One of the most interesting exhibits was the Inductoscript of the Rev. F. J. Smith. This is a method for reproducing figures and pictures by the electric discharge. The original design or object to be copied is laid in contact with an ordinary photographic plate, which is placed upon a conducting sheet of metal. A discharge is passed, for a fraction of a second, between the object and the metal plate. The photograph is then developed in the usual way. Bromide paper can be used for the purpose. The best results were obtained by discharging in oxygen under a pressure of about two atmospheres.

Prof. Frank Clowes has a new safety lamp adapted for testing the air for inflammable gas or vapour. It is an ordinary miner's lamp fitted with a small cylinder of compressed hydrogen. The fire-damp is estimated by the length of luminous cone within the hydrogen flame, when exposed to the inflammable gas. It seems probable that this lamp will replace the electrical device of Liveing, which has long been used for this purpose.

Sir David Salomons and Mr. L. Pyke exhibited a machine for converting a continuous current at ordinary supply-main potential, into an alternating current of about 4 amperes at 200 volts, having a frequency of about a million ~ per minute. The driving is by means of two 2-kilowatt electromotors, their armatures arranged to revolve in opposite directions. The field and armature of the alternator are carried upon the inner ends of the armature shafts. Iron has been eliminated, except from the inside surfaces. The secondary or armature winding is arranged in a Kelvin zig-zag of 276 parallels. The field consists of 138 double-pole magnets. These exhibitors also had a continuous to alternating current transformer, a small inductor dynamo and motor, and a small high-tension transformer.

Major Holden showed some hot wire ammeters and voltmeters. The wire is strung between two rollers, in such a way, as to produce the greatest possible sag. He claims an accuracy of 1 per cent. for this instrument. We can only hope that he is not mistaken. The same exhibitor has a small portable voltmeter for rapidly ascertaining the E.M.F. and internal resistance of a galvanic cell. This requires two readings, the first being taken through a resistance of about 8 ohms; before observing the second reading, a key is pressed, which diminishes the resistance to 2 ohms. The calculations are very simple, the results being arrived at graphically on squared paper.

NEW PATENTS—1893.

8,712. "The magneto-electric brace." J. Foy. Dated May 1st.

8,722. "Improvements in or relating to dynamos or electric motors." A. J. Boult. (Communicated by O. Patin and L. Levavasseur, France.) Dated May 1st.

8,742. "Improved methods of and apparatus for transmitting signals or electric impulses." D. Young. (Communicated by C. Cuttriss, United States.) Dated May 1st. (*Complete.*)

8,802. "Improvements relating to the electric lighting of railway carriages and other vehicles." O. S. Ruddock. Dated May 2nd.

8,808. "Improvements in electric accumulators or storage batteries, partly applicable as a constant primary element." H. Lehmann. Dated May 2nd. (*Complete.*)

8,812. "Electrical apparatus for raising the shutters of telephone indicators." C. D. Abel. (Communicated by Société Générale des Téléphones Reseaux Telephoniques et Constructions Electriques, France.) Dated May 2nd.

8,901. "Improvements in microphones." E. J. P. Mercadier and J. M. Anizan. Dated May 3rd.

8,908. "Improvements in apparatus for the electrolytical decomposition of brine, and other liquids." M. Guthrie. Dated May 3rd.

8,925. "Improved electrical time transmitter and alarm." H. L. Leconte and L. A. Meyer. Dated May 4th.

8,952. "Improvements in electric accumulators." F. W. Ellermann. Dated May 4th. (*Complete.*)

8,958. "Improved apparatus for applying electricity to the body." C. G. B. Rigola. Dated May 4th.

8,969. "Improvements in switching arrangements at telephone exchanges and subscribers' instruments." G. J. Somerville and R. McLean. Dated May 5th.

9,039. "Improvements in autographic or copying telegraph apparatus." S. P. Denison. Dated May 5th. (*Complete.*)

9,090. "Improvements in or relating to the parallel working of alternating electric current generators specially applicable in connection with gas and similar engines." W. S. Boult and C. R. Boult. Dated May 6th.

9,092. "Improvements in or relating to the 'capping' of electric incandescent or glow lamps." W. S. Boult and C. R. Boult. Dated May 6th.

9,126. "An electric arc lamp, improved method for maintaining a uniform arc." J. Jeyes. Dated May 6th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

15,299. "Improvements in electrical signalling apparatus, chiefly designed for police service." W. R. Lake. (Communicated from abroad by the New Haven Clock Company, of America.) Dated September 9th. The objects of the present invention are as follows, viz.:—To provide for avoiding the accidental starting of the main receiver at the central station owing to a too great reduction in the resistance of the resistances placed in the line, by arranging the substations, and hence the resistance magnets in groups composed so that their location on the same line will not reduce the resistance therein sufficiently to permit the starting magnet of the main receiver to be operated. To provide for restoring the variable signal transmitters to their normal adjustments by automatic mechanism controlled by the current, instead of relying upon the current itself to do the work. To provide for the central station an improved gang-switch adapted to simultaneously cut in and cut out all of the sub-stations. To provide a simple, compact, and safe citizen's transmitter, having its key and circuit-changing mechanism isolated, and furnishing it with a supplemental private wire attachment. To provide for automatically turning the gas off and on at the substations simultaneously with the exposure and retirement of the visual signal thereat. 12 claims.

15,403. "An improved method of actuating electrically propelled tramcars." W. S. Boult. Dated September 11th. Relates to the use of a divided transformer, one half of which, consisting of the primary or inducing coil and its core, mounted on a trolley, travels along the culvert containing the main or mains supplying it with current, and the other half, consisting of the secondary coil and its core, is carried by the tramcar. The primary half of the transformer may be hauled along the culvert solely through the magnetism between this and the secondary half, or special auxiliary magnets, or a motor on the trolley may be used as found necessary or desirable. 14 claims.

15,414. "Improvements in connection with electric lamps for signalling and advertising purposes." C. E. Kelway. Dated Sep-

tember 11th. Consists, firstly, in arranging in a suitably sized and shaped frame a number of electric incandescent lamps, preferably in parallel lines, and at any desired distance apart. Each of these lamps is connected to suitably arranged insulated wires, forming part of a circuit or circuits, connected with an electric current-producing apparatus such as a dynamo, or primary, or with a secondary battery. In the circuit is placed a keyboard or compound switch, having a terminal for each letter of the alphabet, and any symbols it may be desired to signal. 3 claims.

15,440. "Improved apparatus for periodically passing currents of electricity through a conductor." R. H. TWIGG. Dated September 11th. The apparatus consists of a cylinder or other suitable receptacle of glass, or other insulating material, having ends of a similar material and provided with a suitable axle or pivot pins. The ends are provided with pins or pivots which project on the inside, and on the outside are connected with the ends of the conductor. A quantity of mercury or other suitable material is enclosed in the cylinder, which is caused to revolve by means of the clock or other mechanism, and as the cylinder rolls round, the mercury makes and breaks contact between the pins at the opposite ends of the cylinder. 2 claims.

17,192. "Improvements in electric distribution." A. WRIGHT. Dated October 9th. The inventor provides each transformer with a switch, whose motive power may be electrical or mechanical, worked by a sensitive fine wire electro-magnet or solenoid connected in series with the secondary circuit, so that when one or more lamps are turned on in the secondary circuit, a small current passes through the magnet coils. This switch, on being thus acted upon, either cuts out a very large resistance or an impedance coil connected between the primary and the supply mains, or bridges over a break between these two; it also short circuits the fine wire electro-magnet or solenoid in the secondary circuit. 3 claims.

17,758. "Improvements in elements for secondary batteries." THE MINING AND GENERAL ELECTRIC LAMP COMPANY, LTD., and J. T. NIBLETT. Dated October 17th. According to this invention a network or woven mesh of lead, lead and antimony or other unoxidisable material or materials capable of being woven into meshes or network is employed. 4 claims.

17,907. "Improvements in electric signalling." A. A. C. SWINTON. Dated October 20th. According to the invention, batteries or generators are replaced by a transformer or induction coil, through the primary wire of which the alternating current supplied is caused to circulate, the secondary wire being electrically connected to the distant bell or signal. 3 claims.

18,280. "Improved submarine cable grapnel." W. C. JOHNSON. Dated October 24th. The inventor constructs the grapnel with two prongs formed by preference of one piece of plate steel, the prongs being made comparatively thin but deep in section, so as to offer little resistance to their penetration into the mud, and yet be of considerable strength. These prongs are fixed to the one end of a broad flat plate constituting the shank, the plane of which is at right angles to the plane of the prongs, and whose other end is attached by a suitable swivelling connection to the grapnel rope. 2 claims.

18,551. "Improvements in or relating to electrical terminals." C. J. HALL. Dated October 28th. The inventor provides a washer-shaped piece of porcelain, or other good non-conducting material, with a hole through it, and adapts it to receive one end of a terminal, the other end extending some distance through the hole. 2 claims.

18,595. "Improvements in electric meters." H. T. HARRISON and G. W. BUDD. Dated October 28th. In an electrical energy or quantity meter, according to this invention the electrical energy to be measured is caused to increase the amplitude (*i.e.*, the length of swing or oscillation) of a pendulum or equivalent oscillating device (for example, a balance-wheel), the number of swings or oscillations whereof per minute is kept constant, and the increase of amplitude is registered by any suitable registering mechanism. 3 claims.

18,775. "Improvements in electric bell indicators." SIEMENS BROTHERS & COMPANY, LTD., G. S. GRIMSTON, and E. PERRETT. Dated October 30th. The object of this invention is a construction of electric bell indicators such that they are readily distinguishable, even when viewed obliquely, and that their actuating gear is protected against dust, damp or other external damaging influences, and against oscillatory shocks. For this purpose the inventors make each indicator in the form of a hollow sphere or cylinder, which may be of thin sheet metal or other light material, and which is mounted so that it can turn about half round a stationary axis presenting always about half its body beyond the face of the board. Within it is fixed on the axis an electro-magnet, the coil of which is connected at one end to the return circuit through the metal of the apparatus, and at the other end by an insulated wire to the conductor from the apartment or place to which this particular indicator is appropriated. A spring urges the indicator to turn round its axis, but in its normal position it is prevented from turning by a detent connected to the armature of the electro-magnet. When the armature is attracted the detent is released and the indicator makes a half-turn, and the half then visible beyond the board being coloured or otherwise marked so as to distinguish it from the face of the board and from the visible halves of the other indicators, can be readily seen by an attendant, even when he looks obliquely towards the board. 2 claims.

18,974. "Improvements in electrical furnaces for the manufacture of phosphorus or other matters capable of being volatised by heat." T. PARKER. Dated November 3rd. According to this invention the furnace is provided at its upper part with a portion or addition which constitutes a retort, which is heated to retain the upper portion of the charge at such a temperature as to prevent condensation of the phosphorus or other volatile matter and by applying heat to the charge at this part, economising electrical heat in the arc of the furnace. 2 claims.

19,198. "Improvements in apparatus for placing electric lamps in circuit in any desired order or sequence." A. G. NEW. Dated November 6th. The inventor arranges a series, group or groups of lamps, so that one terminal of each is connected to a lead or main wire common to all the lamps. The opposite terminals of each lamp are connected to a separate wire, which is carried to the contact-making device, which forms the essential feature of the said invention. This consists of a number of metallic bars or plates, corresponding to the number of lamps in the frame. Said plates are arranged longitudinally, with strips of insulating material between them, and each separate plate is connected by means of a wire to one terminal of a lamp. Above the bars or plates is arranged a number of transverse bars, working within vertical guides or the like, and provided with a key for depression against the tension of a spiral spring, or like means for restoring said bars to their normal position. Contact screws or pins are attached to the bars, so that when each one is depressed, electrical contact is established between it and certain of the insulated plates, so that any given sign, device, or arrangement of lighted lamps corresponding to the contacts upon the key is reproduced at any distance from the keyboard. 4 claims.

22,627. "Improvements in electric locomotives or electric motor cars." S. P. HOLLINGSWORTH. Dated December 28th. The inventor arranges the armature of the motor concentric with the car axle and supports the field-magnets in a frame flexibly or yieldingly supported in the truck frame. He connects the armature with the wheels and axle by flexible couplings, through a clutch of peculiar construction which, briefly stated, consists of two members, one of which is connected to the armature, and the other to the wheels and axles. A liquid, such as oil, is interposed between the two members of the clutch, and the flow of the liquid is controlled by suitable valve mechanism. When the regulating valves are fully closed, the two clutch members are connected to move together at the same speed. When the regulating valves are fully open, one clutch member may rotate without moving the other. By suitably adjusting the regulating valves to vary the flow of the liquid between the clutch members, the speed of the driven member of the clutch, and consequently the speed of the vehicle may be varied at will. 8 claims.

CORRESPONDENCE.

Relative Safety or Danger of Electric Light Currents.

We have read Dr. Waite's letter upon this subject, with interest, and agree with him as to the necessity of a scientific investigation by experts, and the publication of results in the technical journals for the benefit of the electro-medical and therapeutical professions.

The subject is of the highest importance, and the discussion and exposition should not be confined, as hitherto, to the reckless ignorance of inexperienced quacks, especially as the science of electro-therapy is continually extending in proportion with the constant increase of central stations being established all over the world.

As wholesale dealers in electro-medical appliances, we have during the last 20 years supplied the leading hospitals and physicians throughout Great Britain with every description of electro-medical and electro-surgical apparatus including many of the well-known manufactures of Messrs. Waite & Bartlett, some of whose specialities have received the highest encomiums from the most distinguished members of the medical profession.

We have, however, found numerous scientists desirous to avail themselves of the convenience of tapping the electric light current for electro-medical and surgical operations, and we have not at present heard of any accidents from the adoption of this modern method of current supply: at the same time we cannot conceal from ourselves the possibility that serious consequences might arise, and think it most undesirable to introduce any element of danger which can be avoided.

The chemically generated currents from either primary or storage batteries require a certain amount of attention, but with proper care they are capable of satisfactorily fulfilling all general requirements of the electro-medical specialist, and if properly constructed they are capable of carrying out chemically the most delicate operations and their absolute safety is undeniable; further their working is less complicated and does not demand such a high degree of technical knowledge and skill as the electric light current requires; these considerations induce us to believe that the chemically generated current will not be superseded by the modern mechanical methods now being attempted to be utilised.

There are various forms of apparatus, such as small transformers, electric drills, bone sawing appliances, and many

other instruments of general utility which have been specially designed and manufactured for working on both direct and alternating currents, specimens of which we stock, in order to keep pace with the times; but whenever they are shown to our customers, especially provincial men, we are met with an enquiry as to the safety of their use and application. Considering the extremely limited knowledge of the currents as supplied from the various central stations in vogue, we feel some difficulty in answering such enquiries and we should not be disposed to supply some of the modern alternating current appliances at present on the market unless convinced that they were to be used by scientists of the highest skill.

We simply state our views upon this subject from a trade point of view, and trust the electrical fraternity and other electro-medical experts will add to the scant knowledge hitherto published relative to the matter in question.

Mackey, Mackey & Co.

May 10th, 1893.

Parks Modification of a Wheatstone Bridge.

Referring to your comments upon my letter *re* the Parks bridge, the proposed Thomson's reverser for transposing the ratio coils, must of necessity do so more rapidly, and thus break the circuit in a less degree than the primitive plug, or rather two-plug arrangement. In fact, with such a reverser any desired transposition, either of *a* and *b*, or *c* and *x* (the four sides of the balance) can be effected almost instantaneously, or practically, indeed, without breaking the circuit at all—a vital consideration in testing submarine cables of any length, though one of no importance in the case of short non-induction lines—hence my suggestion.

As to the *non*-inconvenience of limiting the "even bridge" values to $\frac{1}{10}$, this, I think, is a point upon which telegraph electricians generally will join issue with you. At the least, in measuring high resistances it would nullify one main object of this form of bridge, viz., the interchangeability of the ratio coils.

H. W. Sullivan.

May 15th, 1893.

The Comparative Costs of Heating by Electricity and Gas Coal.

Your attention may have been called to a note in a contemporary interested in gas lighting, criticising Mr. Crompton's lecture at Hove, and making a comparison between the cost of electric heating and the cost of coal. Taking electricity at 5d. per unit, the price of coal, it is stated, should be equal to £7 7s. 1d. per ton. I should be glad if you would allow me an opportunity of pointing out to your readers that Mr. Crompton in his lecture told his audience that electrical heating, although it appeared costly, calculated in the manner adopted by the paper referred to, is not so in reality when the heating has to be applied for short periods of time and only at such points where it is actually required. A large number of cooking operations come under this head.

The theoretical value in heat units of a ton of coal and its practical value when burned in the average stove are two different things. Probably about 50 per cent. of the heat passes up the chimney in the form of products of combustion, and this loss alone would double the price of coal when compared with electricity. For short operations coal is expensive, for a fire is of little use during the first half hour of its existence, and when the fire is done with a considerable amount of heat is lost in its expiring embers. With electricity the matter is very different, the full heating effect of the current is experienced almost instantaneously, and, owing to the fact that there is no combustion, the heated conductor may be enclosed within or attached to the apparatus in use. Thus practically the whole of the heating effect is utilised without waste in starting or stopping, for immediately the work is done the current is switched off and no loss is experienced. From the above facts I consider a fair comparison of electricity with coal would be as 2 to 1. This is for some cooking operations, but not all. Thus the electric oven completely turns the tables on its opponents. The oven, which is entirely enclosed, is heated, say, to 400 degrees in 15 to 20 minutes at double the cost of gas or coal, but as there are no means for the heated air to escape, the electricity may be entirely turned off when this heat is attained. But for the fact that there must always be some slight loss of heat through the walls of the oven, no more heating would be required. By allowing, however, 25 per cent. of the original current to pass through the oven, the full heat may be maintained, and cooking operations carried on indefinitely. Therefore, if electricity costs twice as much as gas or coal to heat up the oven in the first instance, it only costs half as much to keep it going.

I have tried the experiment of heating up an electric oven to 400° Fah., and, after shutting off all current, taken tests for the next two hours. At the end of that time the temperature was still 250°, which is sufficient for many cooking operations originally commenced at a higher temperature. The cooking carried on during the last two hours would not have cost a single cent., in fact, the electric oven acts like a baker's oven, which, being heated early in the morning, has to cook afterwards by means of the heat retained.

It is a very simple matter to calculate the cost of carrying out small cooking operations. For instance, taking the usual pressure of 100 volts, a unit will give us 10 ampères for one hour. For heating purposes electricity is supplied by many companies at a lower rate than for lighting, owing, no doubt, to the fact that cooking is mostly carried out during the day. Taking the price at 5d., we get the following :—A large size electric toaster will toast perfectly two rounds of bread in one minute. The toaster takes 7 ampères at 100 volts. If this apparatus is used for one hour it will cost seven-tenths of 5d., *i.e.*, 3½d. At the rapid rate, however, at which the toaster will work it will probably not be required more than 10 minutes at a time, and the current for this would cost one-sixth of 3½d., or a fraction over ½d. Three minutes, however, must be allowed for the toaster to get to its full heat before using, and therefore we must add one-twentieth of 3½d. We may very well say that the toaster will work in the most efficient and satisfactory manner for about 10 minutes at the cost of less than 1d.

The electric griller will grill four chops or six cutlets in 10 or 12 minutes, using 6 ampères. Add to the time taken in actual cooking, three minutes to heat up the plate in the first instance, and we find that current will be required for about 15 minutes at 6 ampères. The cost of this would be about 1½d. It is convenient to remember that at 5d. a unit we are paying ½d. per ampère per hour. To boil a quart of water requires about 3½ ampères for 10 minutes, but if we allow ¼-hour for this operation the cost is about ½d. It is quite a question whether the usual spirit stove would be as cheap.

If we add to the above the many great advantages and saving due to the absence of waste heat, smell, smoke and dirt, the cost of electric heating for many cooking purposes is certainly very little, if at all, in excess of coal. I doubt very much, when all the bye savings are taken into consideration, whether it is dearer at all.

The above figures are taken on the assumption that electricity is supplied at the price of 5d. per unit. It may be obtained, however, at 4d. per unit at the present time in the City for heating purposes, and in other parts of the country it is as low, and at St. Pancras it is charged at 3d. These prices make the comparison still more favourable. The convenience of being able to switch on or off the heating power at will, and to carry on the cooking operations in any part of the kitchen without reference to chimney accommodation will certainly bring electric cooking into favour.

Large numbers of experts have seen the Crompton electric cooking apparatus, and without exception they have declared in favour of its use. The only point which seems to cause them any doubt is the question of safety, but this they soon see is only a "bogey" raised by our opponents. There is absolutely no more danger to life or limb in using electric cooking apparatus than in the use of the ordinary incandescent lamps, for all are worked with the same pressure.

H. J. Dowsing.

May 16th, 1893.

Mr. J. J. Mann.—The name of a system is certainly unimportant. The novelty less so. On the practical question your letter simply repeats views which have been controverted, and we cannot now re-open the controversy long since closed.